INFORMATION REPORT INFORMATION REPORT

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2. In some cases, the articles were translated in their entirety; in other cases, they were summarized.

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Herald of Antiaircraft Defense

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Vestnik Protivovozdushnoy Oborony, No 4, April 1963

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Competition of Worthwhile Efforts Continues (Page 2)

Summary:

In honor of the 60th anniversary of the CPSU in 1963, Komsomol members and young soldiers of PVO Strany Troops decided to continue the "competition of worthwhile efforts," which was begun in honor of the 14th Congress of the Komsomol, and continued in honor of the 45th anniversary of the Soviet Armed Forces. For example, the soldiers of a radar podrazdeleniye pledged to improve their training results in the long-range detection of targets. The personnel of an aviation chast' is making efforts to have every pilot acquire technical skill equal to that of a technician 1st Class or 2d Class. The Military Council of the PVO Strany Troops has examined and approved the initiative of young soldiers and Komsomol members and has suggested that it should be followed by all chast' and podrazdeleniye of the troops.

Innovators Receive Recognition (Page 2)

Summary:

A survey was conducted of the extensive and useful work performed by innovators and inventors of PVO Strany Troops during the past year, and awards were presented by the Commander in Chief of PVO Strany Troops in recognition of the services of the best inventors and innovators, as well as work organizers in chast' and military educational institutions. The recipients of awards included officers SHIRYAYEV, KALGANOV, SHIRMAN, REZNIKOV, PAVLOV, TSYLOV, BURMISTROV, TREGUBENKO, TSYBULEVSKIY, MONAKO, and SOKOLOV; officer candidate GAVRILENKO, Sr Sgt ANTIPOV, Pfc ALUSHKOV, [civilian] employee of the Soviet Army SIMAKOV, and others.

Major Acquires Rating of "Master-Operator" -- text and photograph by Capt. V. KOROTKOV (Page 2)

Summary:

Maj I. POPOV, together with other officers, took a 2-day examination for the rating of "master-operator". By intensive study, he had acquired an excellent knowledge of radar equipment. He first acquired the grade of "rated specialist," and then passed his examination for a "master's" rating. The Photograph shows Maj I. POPOV during a training exercise.

Make a Thorough Study of Leading Achievements and Apply Them Widely --

Editorial (Pages 3-6)

Summary:

The leading achievements of innovators constitute an asset belonging to all the people, which must be utilized wisely to speed up the movement of Soviet society toward Communism. Therefore, the Central Committee of the party demands that all innovations be carefully studied, publicized, and introduced into practice.

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This applies equally to the activities of commanders, politcal organs, and party organizations, in solving complex problems for the continued strengthening of combat capabilities and combat readiness of chast' and podrazdeleniye. The generals, officers, sergeants, and soldiers of PVO Strany Troops, as well as the other branches of the Armed Forces, are constantly improving their moral-political and combat qualities, and advancing their theoretical knowledge and practical skills to meet the demands of Soviet military doctrine. During this process, many patriotic projects have been initiated by the soldiers.

For example, the personnel of the Nth antiaircraft rocket chast' has a high degree of combat training and discipline. During the past training year, more than 80 percent of the personnel in podrazdeleniye of the chast' become rated specialists. The combat equipment is maintained in exemplary condition. The personnel of the chast' is striving to achieve even higher results in the present training year. Specific measures have been taken for all officers to make a thorough study of the theory of rocket firing, including firing at targets operating under special conditions.

Constant attention is given to leading methods used by rated specialists. The chast' has made a thorough study of the work performed by the best officers, sergeants, and specialists. Many of them write articles in the military press. All this has a good effect on the improvement of training.

The political section of the Nth radiotechnical chast' has acquired vast experience in the propaganda of new forms and methods of the training process. In the past training year, the personnel of the chast' acquired high results in combat and political training. For example, the company under the command of Capt REZNIKOV has received outstanding ratings of 70 percent of the personnel. The crews have achieved complete interchangeability. The achievements of Capt REZNIKOV, of Sr Lt NIKOLAYEV who is deputy commander of the company for political affairs, of the radar station crew headed by Sr Lt MOZGOV, and others, have become known to the entire personnel.

A number of commanders and political organs have improved the popularization of new methods. For example, a political section, which includes Officer KOSTENKO, prepared a detailed plan for the winter period of the training year, devoted to the study of leading achievements in the most important matters of training.

Various forms of party-political work are used for the popularization of noted achievements, including scientific-technical and methods conferences, publication of pamphlets, and display of posters.

There are still shortcomings in the dissemination of leading achievements among units of PVO Strany Troops. Some commanders, political organs, and party organizations, underestimate this type of work and do not understand its current role; they fail to realize the great importance of propaganda in this sphere. The tasks of PVO Strany Troops have greatly increased under present conditions, and have made it necessary to organize the combat training of all branches of the army on the basis of complex training.

The tactical training of troops has also become much more complex than in the past. The perfection of an organic unity in combat operations by various branches of the army complicates troop control and necessitates the extensive use of automatic equipment, electronic computers, and other devices and mechanisms.

Another circumstance must be taken into consideration. Obviously, the new conditions of training and uninterrupted combat duty in PVO Strany Troops create great physical and moral strain for the entire personnel. To enable each soldier to understand his personal responsibility for the performance of his combat duty and to promote the continuous improvement of political and military-technical training, it is necessary to conduct daily party-political work. This means that the slightest relaxation in the organization of political and military education will have a negative effect on the quality of combat training, the state of military discipline, and the performance of combat duty.

Mar Su R. Ya. MALINOVSKIY, Minister of Defense, demands that the officer cadres should constantly search for improved methods of troop training and introduce such methods into practice. Therefore, the functional duties of commanders and staffs at all levels should include a thorough study of current problems of the whole training process, and the encouragement and advancement of new, progressive principles and methods.

In this connection, the responsible role of military leaders should be particularly stressed. N. S. KHRUSHCHEV stated at the January 1961 Plenum of the Central Committee of CPSU: "If a leader is unable to introduce leading methods, he would be unfit to be a leader, he does not have the necessary abilities, and cannot occupy such a high position. He does not justify the trust placed in him." Continuing this idea at the November 1962 Plenum, KHRUSHCHEV said: "We must scrutinize through a powerful magnifying glass and subject to the fire of criticism everything which hinders our progress. One must clear the way for new, healthy growth.... All our activities must be devoted to these tasks."

Therefore, the organizational work for the propaganda and dissemination of leading achievements must be raised to the level of its political importance, and each soldier must be inspired to strive for an exemplary performance of his duty.

The fourth month of the new training year is coming to a close. A considerable contribution has been made by the soldiers to the improvement of their political and military-technical knowledge, their physical hardening, and tactical training. It is the immediate duty of commanders, political organs, and party organizations to make a thorough analysis of results achieved so far, to uncover shortcomings and eliminate their causes, and to equip officer cadres with progressive methods of personnel training.

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PARTY-POLITICAL WORK AND MILITARY EDUCATION 50X1-HUM

Learn to Work in the Leninist Style -- by Maj Gen Arty S. K. CHUBAROV (Pages 7-13)

Summary:

The Party has given extreme importance to the training of military cadres in the Leninist style, as this is considered the most important condition for proper control of the troops and for maintaining a state of constant combat readiness.

The Leninist style implies high ideological convictions, adherence to principles, and a critical approach to one's work. The Marxist-Leninist world outlook is the basis of a Soviet officer's ideology. However, it should not be reduced to theoretical knowledge alone. The new Party Program demands that in the behavior of each individual, and in the activities of each group or organization, Communist ideas must be coordinated organically with Communist actions.

An officer's ideological convictions are demonstrated mainly by his constant concern for increasing combat readiness, achieving high results in combat and politcal training, and strengthening discipline.

Most of the officer cadres have deep ideological convictions, and they consider each one of their actions from the point of view whether it is useful to the party and the people, and whether it strengthens the combat power of their country. They do not stop before any difficulties or deprivations, if it is in the interests of the cause.

However, individual officers do not give enough attention to raising their ideological and theoretical level and neglect their Marxist-Leninist training. Sooner or later they lose their sense of responsibility for the performance of their military duty and show failures in their work.

An important trait of an officer is to be demanding toward his subordinates; however, this should have nothing in common with rudeness.

Political maturity and high ideological convictions are demonstrated by a critical approach to one's work.

There are still individual instances among cadres of PVO Strany Troops when officers have attitudes of self-satisfaction, self-delusion, or conceit. The best remedy against this is critism and self-criticism.

The close relationship between commanders and the masses of soldiers has become a well-known tradition among officers of the Soviet Armed Forces.

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Party-political work, which has been stepped up as a result of the October 1957 Party Plenum, has had a beneficial effect on conditions in the Armed Forces. The Leninist tradition of personal contacts between commanders and subordinates has been further developed.

Unfortunately, some commanders and chiefs still prefer to keep aloof from their subordinates and show an extremely official or even arrogant attitude. At a meeting of party activists of the Ministry of Defense, discussing the results of the November Party Plenum, Mar Su R. Ya. MALINOVSKIY severely criticized such commanders, who stress their superiority in rank and position and believe that the infallibility of their judgments and actions is guaranteed by their official position and military rank.

The party has given special attention to the education of military cadres in the spirit of efficiency. The slightest omissions, carelessness and in efficiency on the part of an officer may lead to great losses. This is especially true in the case of PVO Strany Troops, which must be ready at any minute to meet the enemy fully armed and to destroy him.

Some officers are unable to bring a difficult problem to its final solution. Having encountered the first difficulty, they wait for instructions and help from higher up.

Army life has so many facets and the tasks to be performed by the troops are so manifold and complex that they demand the ability for quick decisions of many problems by the officers. However, commanders and political workers sometimes complain that they do not have enough people and time to cope with all the problems. An analysis of their work shows that they lack proper organization. Some try to do everything at once and are unable to bring anything to a conclusion; others try to do everything personally, without delegating jobs to their assistants, above all to party members.

A commander must constantly seek the support of party and Komsomol organizations, and of collective reasoning and experience.

In checking the fulfillment of decisions and tasks, every effort must be made to achieve positive results, to guide and train people in the proper manner, to warn them against possible mistakes, and to raise their sense of responsibility. This requirement is not always met. Some commanders and staff officers merely collect facts, determine shortcomings, and prepare reports, instead of engaging in organizational work in chast' and pedrazdeleniye.

Some officers in PVO Strany Troops still fail to conduct regular checks on the fulfillment of orders and instructions. As a result of laxity in control, serious failures in the work are inevitable.

Party organizations play an enormous role in teaching individuals to acquire a Leninist style of work.

(A captioned photograph by K. FEDULOV, showing Sr Tech-Lt A 50X1-HUM Party secretary of a technical operations chast'; Re-enlisted Sgt I. GUSEV; and Sr Tech-Lt V. SHEVCHENKO (both party members); appears on page 11.)

<u>Go the Right Way from the Very First Steps</u> -- by I. P. LYSYY (Pages 14-18)

Summary:

In one of the chast' of PVO Strany Troops, a "Young Officers' Day" was recently held, during which meetings and discussions took place between experienced commanders and war veterans and young engineers, technicians, and platoon commanders. Two veterans of the October Revolution and of World War II, A. L. PLYATSKOVSKIY and Col (ret) M. S. MOROZOV, spoke to the young officers and shared their past experiences and observations with them.

One of the questions brought up during the discussions was the perfection of military, political, and technical knowledge of officers and the improvement of their professional skills.

Most of the graduates of military educational institutions who enter on duty have a certain amount of acquired knowledge, which permits them to join the ranks with confidence and to do a good job from the very first days of independent work. However, some young officers are tempted to "coast along" for a while with their old knowledge; this may prove very embarrassing when soldiers ask questions which the young officers are unable to answer. For example, Engr-Lt Yevgeniy ZHILYAYEV had stowed away his textbooks when coming on duty, thinking he would not need them for a while. A few days later, a soldier asked him to explain "the physical essence of the work of a phantastron." ZHILYAYEV tried to give an explanation, but it wasn't very convincing, as he found he had forgotten what he had learned a long time ago. The soldier "very tactfully" remarked that perhaps they might talk about it some other time, when the lietutenant was "not so busy." Young officers should not evade the answers to questions; however, if they are unable to answer, they should simply say they don't know and promise to look up the answer in a book.

Young officers should constantly study and increase their knowledge, and not be satisfied with what they learned at a school or academy. To help the young officers with their studies, it is necessary to have a technical library easily available.

In performing their new duties, young officers need the encouragement and confidence of their superiors. This does not mean, however, that young officers should be left completely to themselves; their superiors should give them help, whenever necessary.

The professional skill of young officers does not depend on technical training alone. An officer also has to be a commander and educator of his subordinates. He has to teach the soldiers and sergeants military skill, imbue them with high moral fighting qualities, arm them ideologically, and educate them according to the principles of the moral code of builders of Communism.

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This code, as Mar Su R. Ya. MALINOVSKIY pointed out, "has given commanders, party and Komsomol organizations a new, powerful means of training the qualities required for victory over a powerful, crafty enemy, i. e. courage, daring, resoluteness, steadfastness, initiative, and an aggressive fighting spirit.

Therefore, the duties and tasks of an officer are much more extensive than they may appear at first glance. His technical and command training must be supported by Marxist-Leninist training, and his methods of training subordinates must be coordinated with his skill in educating them.

Some young officers at the meeting admitted that although many of them were leaders of political study groups, not everyone of them could be called a skillful propagandist. They realized that the art of educating people was difficult and that they had to learn more about it. They discovered that an individual approach had to be used toward different subordinates.

Sr Lt Petr TITOV spoke about the study of Marxism-Leninism by young officers and their achievement of a high, socialist culture.

The participants in the "Young Officers' Day" discussed many other problems of military pedagogy and psychology, on the planning or a work day, and on the ability to maintain and encourage initiative among the soldiers.

The chast' [in which this meeting took place] takes proper care of its officers. All married officers are provided with apartments, and the single officers live in well-furnished dormitories. Twice a month a mobile store (avtolavka) with industrial goods and food supplies visits outlying posts. Movies are shown regularly. Officers and their families are provided with transport facilities to attend theaters.

The life and leisure of Soviet officers is completely unlike ("like the difference between day and night") the life of officers of the old Russian Army or the army of any capitalist country in our time.

(A captioned photograph on page 15, by V. KRISTALINSKIY, shows M. S. MOROZOV (left) and A. L. PLYATSKOVSKIY, both old party members and veterans of two wars, speaking to young officers about Soviet army traditions and the responsible work of Soviet commanders in training their subordinates.

A captioned photograph on page 16, by G. OMEL'CHUK, shows Maj Yu. ZHILIN, commander of a squadron, and Maj N. KORZHOV, secretary of a party organization, after completion of their flights. All pilots in this squadron have a high level of traing and are recognized as experts in the interception of targets.)

A Matter of Conscience and Honor -- by Lt Col V. I. SUVOROV (Pages 19-20)

Abstract:

The article discusses the activities of Sr Engr-Lt KUZNETSOV, who is an expert on radiotechnical equipment and who has helped many of the soldiers in his podrazdeleniye to acquire special technical skills and to understand principles of radio and electrical engineering.

(A photograph of Sr Engr-Lt KUZNETSOV by V. GATCHIKOV appears on page 20.)

COMBAT TRAINING

Each Officer Must Have High Training Skill -- by Col T. V. YEROFEYEV (Pages 21-24)

Summary:

Despite the extreme importance of the training (metodicheskaya) skill of officers, some chast' and podrazdeleniye give little importance to it. As a result, officers start training the personnel without having any instructions on how best to organize and conduct such training classes.

At present, the personnel of chast' and podrazdeleniye of PVO Strany Troops has a high level of general education, preliminary technical training, and cultural development. Therefore, higher demands are placed upon the training skill of officers. Officers must be instructed in the most efficient methods of working with subordinates, and must be encouraged to improve their knowledge and skills by studying military-pedagogical literature and materials on training methods published in the press. By their words and deeds, officers should constantly show an example to their subordinates and help them to acquire the necessary skill in handling combat equipment.

Some officers believe that the degree to which certain problems are assimilated, i.e. the effect of training as a whole, depends on the trainees. However, this is not entirely true. The method of training plays a very important role. The following example proves this point.

In a radiotechnical chast', the preliminary stage of the training of radar operators took place in the podrazdeleniye. As a result, they acquired different levels of knowledge and skills, since each instructor had his own training method. Some of them allowed the soldiers more initiative, others merely transmitted their own knowledge to them. The chast' commander revised the training practice of radar operators and assigned the training to Reenlisted Sr Sgt KOL'TSOV, who had a good knowledge of complex training methods, including both theory and practice of radioelectronics. This enables the operators to acquire thorough knowledge and to master several related specialties.

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The topics to be used in instructing officers in training methods must be chosen in connection with local conditions and specific tasks to be performed by the chast' and podrazdeleniye each month. As a rule, best results are obtained when the officer training classes are held monthly under the supervision of the chast' commander. Sometimes this is not possible because of the location of a particular unit. In that case, experts on training methods are sent from the higher staff to the remote garrisons to conduct such classes.

Some officers believe that the main thing in training personnel is to teach them the mechanical and speedy performance of certain duties. This method is incorrect. An officer must inspire his subordinates with a love for his specialty and a desire to be thoroughly familiar with his work and be able to perform the required takss under any conditions. One must remember that a soldier of the Soviet Army is not an automatic machine; he is in command of the equipment.

Occasionally the training of officers of various specialties is conducted in a single group within the podrazdeleniye. However, this is not practical, since a radar specialist would be more interested in matters of radar equipment, while signal communications officers would be more interested in radio sets. As a result, the perfection of training skills of officers in podrazdeleniya, especially platoon commanders, or chiefs of stations and crews, does not always meet modern training requirements.

It has become necessary to revise the composition of officer study groups, especially these including young officers, so that they may be trained in their specialties on a high level. It would be expedient, for example, to have the commanders of radar companies and their deputies for political affairs attend training under the supervision of the chast' commander, since most of them would have the same background of knowledge, and would be concerned with the same problems. It would also be desirable, if the location of chast' and podrazdeleniye makes it possible, to corm training groups of platoon commanders, chiefs of radar stations and of crews, technicians, and engineers. This would be an important factor in improving the quality of training.

To be a training expert an officer must be thoroughly familiar with the equipment and weapons, and be able to train his subordinates to use them.

Training conferences are of great importance in perfecting the training skill of officers of podrazdeleniya. These conferences should be conducted before the start of the training year or period, with the participation of all categories of officers. The most important problems should be discussed at the conferences, and uniform methods should be adopted for the training of major specialties.

Constant attention to officer training must be given during the periods between training conferences, and all training measures must be conducted with the participation of commanders and staffs of all levels, political workers, and leaders of party organizations. Only in this way can high results be achieved.

Methods councils play a considerable part in improving the training skill of officers. However, some of them do not have any work plans or any definite idea of what they are supposed to do. Some councils include in their work plans the problems which should be selved by commanders themselves. An excessive work load prevents the methods councils from concentrating their attention on the main issues.

The Nth aviation chast' has been highly successful in performing its tasks of combat and political training for the past few years as a result of the prompt reactions of the chast' commander, the methods coucil, and the political apparatus, to any shortcomings occurring in the advancement of the officers' training skill.

Strive for Thorough Knowledge of the Principles of Rocket Launching -- by Maj Gen Arty V. D. GODUN (Pages 25-27)

Summary:

In a future war, should it be unleashed by the imperialists, the personnel of antiaircraft rocket troops, as well as all other Soviet soldier, will be engaged in active, continuing, and uninterrupted operations. Therefore, the soldiers must have the necessary moral fighting qualities; they must be able to use their weapons skillfully in combat and be ready to replace any specialist who may become a casualty. All this has to be achieved now, in the process of daily training.

One of the combat training tasks is combat firing (launching). To obtain good results, every specialist in a podrazdeleniye must be thoroughly familiar with the equipment, have a good idea of the launch pattern, the preparation of equipment for combat, and the effects of errors on the destruction of targets. Therefore, it is necessary for engineering and technical personnel to know the rules of launching antiaircraft missles, in addition to being familiar with the technical maintenance.

The widespread use of electronic computing machines, and especially the automation of many processes, have placed new requirements on the servicing personnel.

During the past training year, a great deal of attention has been given to the rocket-launching training of personnel. All this has had a marked effect on raising the level of combat training.

However, there are still shortcomings. Some officers are not too familiar with the launching rules and permit errors in the performance of tasks and the conduct of prelaunch training; they have occasionally been unable to calculate the probability of hits. All this has had a negative effect on the results of launching exercises.

During the rocket-launching contest, some officers were unable to answer a number of questions on the theory and rules of rocket launching.

In the current training year, many changes have been made to improve rocket launch training. Staffs and commanders of podrazdeleniye have given much attention to the planning of training. At present, all categories of officers are included in the training, and many additional topics have been included in the training plans for commanders.

A thorough study of the theory of rocket launching would be unthinkable without a solid mathematical foundation. This requires a study of higher mathematics, including algebra, trigonometry, geometry, differential and integral calculus.

The officer training can be greatly improved if the classes on launching rules are closely coordinated with the study of equipment.

Special reference should be made to the conduct of rocket launching contests. These are extremely useful when all officers take an active part in them. During the current training year, the contest program has been revised, and all officers regardless of their specialties or official positions will be required to take part. The number of questions on which a contest is to be held hasbeen expanded, the main subjects being practical tasks on the theory of launching, launch control, and preparation of equipment for launching.

Preparations for the contest have already begun and many officers are studying the rules of launching and the technical equipment.

Since independent study has become the principal method of mastering the theory and practice of rocket launching, steps have been taken to regulate the officers' workday. In addition, one whole day has been assigned for independent study. On that day the officers, under the supervision of their immediate superiors, study in classrooms according to individual plans. During these periods the officers arenot to be distracted from their studies, except for extremely important reasons. On these days, sergeants conduct the training of soldiers.

The senior chiefs and officers of staffs have made noticeable changes in their style of work in the podrazdeleniye; they now try to conduct seminars or consultations on important problems everytime they visit a podrazdeleniye.

Questions concerning the mastery of rocket-launching principles are often discussed at meetings of party bureaus, and party and Komsomol members. Party organizations want every party member to show a good example in training and to be an active propagandist of military-theoretical knowledge. /

Officers have great hopes for the success of logical computer machines, which are soon to be introduced into the training process of podrazdeleniye.

It would be wrong to assume that everything has been done so that each officer would be an expert on the principles of rocket launching. The training of engineers of technicians in podrazdeleniye is still being neglected, as the training plans have given little attention to this category of officers. As a result, some of them show little interest in studying the theory of launching and consider this a matter of secondary importance.

The chiefs who are responsible for the orgainzation of combat training during the second training period must organize the work in such a way that each officer would improve his specialized knowledge. For this purpose, some corrections will have to be made in the combat training plans.

In conclusion, it is noted that the officers are inadequately provided with textbooks and other teaching aids. The Military Publishing House has not yet published a textbook on the theory of rocket launching.

Solve the Following Problems (Page 27)

Text:

1. The first artificial earth satellite, as the last stage of a rocket, weighed about 4,500 kilograms. How much fuel would be required to achieve the first cosmic speed (8.2 kilometers per second) without considering the thrust of the other stages. Suppose that Vr [rocket speed] = 3,000 meters per second, and K [constant] = 0.8.

2. The weight of an equipped rocket is equal to 1,250 kilograms. Its weight without fuel or oxidizing components is 625 kilograms. Compute the outlet velocity of the rocket if K = 0.8 and Vr = 1,900 meters per second.

3. The sustainer engine of a rocket has a per second fuel consumption of Gc = 13 kilograms per second, gas discharge speed of 1,000 meters per second, and pressure at the exhaust nozzle Po = 9 kilograms per square centimeter with a nozzle cross-section Sa =250 square centimeters. Determine the thrust of the engine. Do not consider atmospheric pressure.

4. What speed will a rocket develop at the end of first stage engine operation, if the weight of the equipped second stage is 1,250 kilograms and the weight of the first stage is 1,000 kilograms. The weight of the fuel is 550 kilograms, K = 0.8, and Vr = 2,900 meters per second.

5. Determine the amount of thrust developed by a rocket engine if the weight of the equipped rocket is 1,030 kilograms, or 480 kilograms without fuel. Duration of engine operation is 3.2 seconds, Vr = 1,800 meters per second, Po is 10 kilograms per square centimeter and Sa = 500 square centimeters. Do not consider atmospheric pressure.

Technical and Firing Contests -- by Engr-Col N. I. SVIRIDOV (Pages 28-29)

Abstract:

Describes the way technical and antiaircraft firing contests are held for academy students of the 3rd and 4th courses and suggests that such contests might be expanded in the future, and conducted not only in academies but also in the chast'.

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Winners of the Lenin Scholarship Speak -- (Pages 30-31)

Abstract:

Two Lenin grant-aided students, Capt A. P. MAKSIN and Capt 3d Rank D. I. FOMIN, relate how they have achieved success in their higher school training. Capt MAKSIN is also identified as a member of a department party bureau at a higher military educational institution.

(A captioned photograph by V. KOSTYLEV on page 30 shows Capt MAKSIN working with tuning equipment.)

(A captioned photograph by Ye. FEDOROV on page 31 shows Capt 3d Rank FOMIN working in a laboratory.)

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A Flight Commander Is a Pilot's First Mentor -- by Col V. P. ILYUSHIN (Pages 32-36)

Summary:

To Fully use the many capabilities of modern aircraft, pilots must be well trained. The flight commander is directly responsible for this training. When a flight commander is both a skilled pilot and a fine instructor, his subordinate pilots quickly master their trade and are safe, combat-ready pilots. The squadron commanded by Maj YEFIMENKO is an example of this. All of the pilots of this squadron have high ratings and can intercept aerial targets in any weather condtions, day or night. This can be attributed to the daily and thoughtful training programs executed by the flight commanders who are all experienced instructors and pilots. A fine example is Maj PAVLOV who is both a pilot first class and a flight commander. None of his subordinates take off one a flight assignment until PAVLOV is sure that they are ready and he is always ready to help if any training difficulties are encountered.

It is, of course, impossible for a flight commander to be a fine instructor unless he knows his aircraft and its capabilities to perfection. He must also know the theory of flight, aerial combat, and aircraft weaponry; in addtion to being familiar with all operation regulations, methodical training methods, etc. Capt KRAYNOV is such a flight commander. He very carefully and methodically preflights his subordinates for an assignment, attentively checks each pilot's flying in executing an assignment, and meticulously reviews each error committed, no matter how minor it may seem. These practices cause his pilots always to do their best, constantly to check their own work, quickly to correct mistakes, and knowledgeably to make decisions.

A flight commander, if he is not a well trained instructor just as if he is not a skilled pilot, cannot cully influence his subordinates. He becomes a passive observer and his duties must be borne by others. He is not truly a commander. He must constantly train to maintain his own proficiency and at the same time he must always be ready to help his subordinates. Here, a fine example is Maj DOROVSKIKH, who completely understands his subordinates and their capabilities so that he is able to guide and direct them in proper channels.

Unfortunately, some flight commanders cannot develop their leadership abilities because some senior commanders do not allow them sufficient commanders even assume all of their flight commanders' responsibilities, restrict themselves to organizing the training process and to giving help only when it is needed.

Flight commanders can aid themselves to become fine instructors by taking part in methods conferences and by carefully training themselves under the tutelage of more experienced pilots. Unfortunately concerning this, such training as flight commanders' check flights is not always executed for a flight commander's benefit. Some such flights are taken only in ordinary weather conditions, for example, where very little beneficial training is received.

Of course, the training of flight commanders in Marxist-Leninist ideology is also of utmost importance as this is a basis of discipline and morale.

(A captioned photograph by G. OMEL'CHUK on page 34 shows Maj A. PAVLOV, flight commander, checking Capt P. NEFEDKOV's knowledge of cabin procedures in a fighter aircraft.)

Against the Underevaluation of Trainers -- by Maj Gen Avn A. I. KHALUTIN, Pilot First Class, and Engr-Col G. M. KALNIN (Pages 37-38)

Abstract:

Discusses advantages derived from the use of flight-simulating trainers, especially the TL-1 and TL-2 trainers.

Excerpt:

Certain difficulties are encountered in the transition from operating trainers to flying aircraft. Examples of these are establishing given flight speeds, changing flight speed by altering engine RPM and angle of aircraft pitch, and establishing or changing rate of climb. This is explained by certain elements of flight being simulated by the trainer without consideration of aircraft inertia, movement dynamics, and instrument delay. Certain difficulties also arise when piloting an aircraft at the moment when flaps are lowered in a landing approach, since lowering of flaps on a trainer is simulated without any noticeable change in aircraft trim and control load.

Experience has shown that the pilot's attention is diverted in a trainer as in an aircraft at conforming stages of flight, but there are certain differences. For example, in a trainer, where inertia with airspeed change is less noticeable than in an aircraft, more attention is paid to the speed indicators. Also, the noise accompanying engine operation is heard in an aircraft which does not happen when operating a trainer. However, this noise does not make flying more difficult, but makes it easier by enabling a distinctive acoustical check of throttle control.

Finally, there is one more peculiarity. As is known, a pilot is distracted to a certain degree by radio traffic while piloting an aircraft. This radio traffic is not present in operating a trainer. Thus, there is a need for pilots to carry on radio communications during training periods. A radio situation should be developed to closely simulate actual flight conditions for personnel who are training in flight simulation equipment. The essence of all this is that traniners should be connected by a general system for the simulation of flight radio communications. As a result, training personnel will hear radio traffic between other pilots and flight controllers and can take part themselves in such radio traffic.

People who have worked with trainers have noticed that aircraft controls are less sensitive than those of a trainer. Also, control movements in an aircraft are accompanied by noticeable sensations of positive and negative g-force, which in the opinion of trainees makes flying an actual aircraft easier in comparison to operating a trainer.

Observation of Training Sequence in Training Operators: -- by Engr-Capt G. G. SULEYMANYAN (Pages 39-41)

Abstract:

Presents general instructions, hints, and examples to guide instructors in training, placing special emphasis on making instruction sequential, i. e., proceeding from the basic to the more complex.

(A captioned photograph by P. GORDIYENKO on page 41 shows Sr Lt V. BUBENCHIKOV reporting on the progress of a training problem to Maj IZOTOV.)

Follow the Example of the Prize Winners -- by Lt Col N. A. FISHCHEV (Pages 42-43)

Abstract:

Reports that for the second year in a row the Pushkin Radiotechnical School of PVO Strany and the Zhitomir Radiotechnical School of PVO Strany have respectively won first and second place in a Ministry of Defense competition for sports activity among higher educational institutions, and discusses sports training at these two schools.

(A captioned photograph by O. GRIGOR'YEV on page 43 shows Capts B. ZHUKOV, Yu. SKOVORODNIKOV, V. CHARUSHIN, and A. KAMIN checking their flight assignments in front of a fighter aircraft. The caption also states that all of these pilots first class can intercept aerial targets in any weather conditions and that their squadron has won the honorary title of "outstanding".)

50X1-HUM

Guided Drone Targets by Engr-Lt Col Ye A. PAVLOV, Candidate of Technical Sciences (Pages 44-46)

Abstract:

Based on material from the foreign press, discusses the development of guided flying targets since World War II. While mention was made of the Ryan Firebee, most of the article was devoted to the description, operation, use, and power plants of the French CT-41 Narval. A table was included at the end of the article, giving external dimensions, launch weight, maximum mach number, and service ceiling of the following drones: Q-5 Kingfisher, NA-273 Redhead-Roadrunner, P-106A and P-107, and Beech Rd-134. The following illustrations of the CT-41 accompanied the article.

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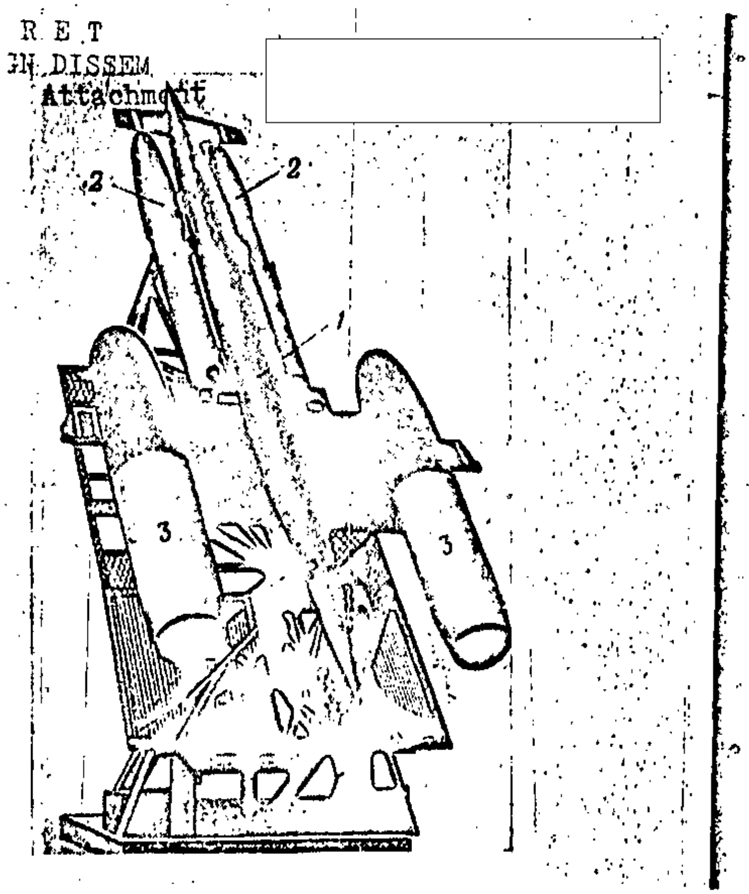

Figure 1. The CT-41 target on a launch platform.
1. target body; 2. launch engines; 3. Sustainer engines.

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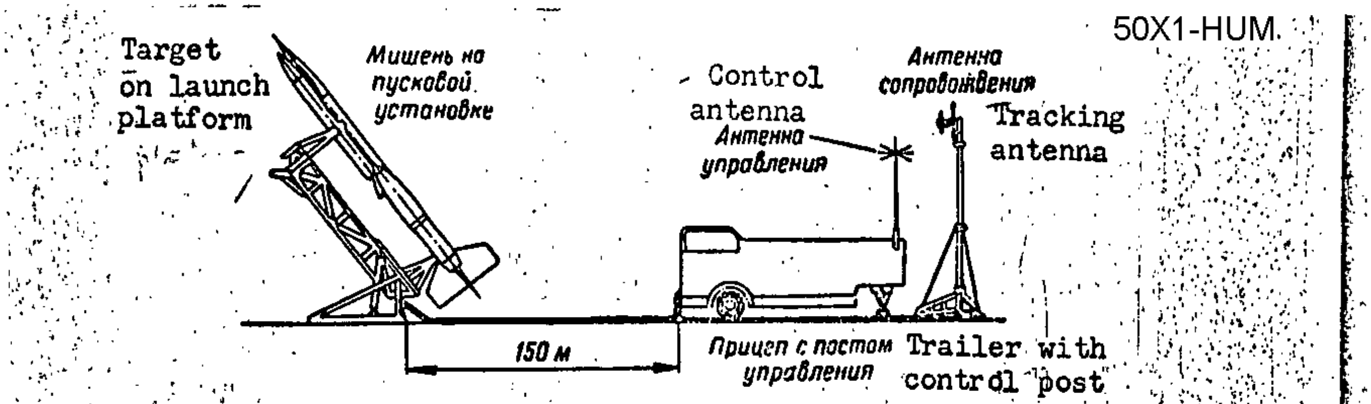

Рис. 2.

Figure 2. Apparatus used in launching the CT-41.

EQUIPMENT AND ITS USE

The Care and Skillful Use of Measuring Equipment -- by Engr-Lt Col M. A. PRONIN (Pages 47 - 51)

Abstract:

Discusses the importance of the correct use, repair, and storage of checking and measuring instruments; states that the main reason for shortcomings in the use of measuring equipment is that personnel are not sufficiently trained and that some personnel have a careless attitude toward checking and measuring instruments; deals at length with the importance of periodic checks of measuring equipment; criticizes unauthorized repair of delicate instruments and nonobservance of equipment manuals and regulations; suggests that non-T/O points equipped with measuring equipment be set up in chast'; and advocates better training of personnel including yearly seminars and on-the-job training programs.

(The caption to a sketch of Capt V. A. SALTANOV, deputy commander for political affairs of a podrazdeleniye, states that he was awarded the Order of the Red Star on the 45th Anniversary of the Soviet Armed Forces.)

(The caption to a sketch of Capt Tech Serv A. A. SPIROV, chief of a technical operations chast' and a technician first class, states that he was awarded the Order of the Red Star on the 45th Anniversary of the Soviet Armed Forces.)

The Use of Radar Equipment Must Be Placed On a Scientific Basis -- by Engr-Col N. P. VTOROV (Pages 52 - 53)

Abstract:

Proposes development of textbooks and training aids concerning use use and maintenance of radar equipment to be used in military training institutions. The author states that the need for such training materials is shown by so many officers upon graduation from schools being unable to use radar equipment properly in spite of their firm theoretical knowledge.

For the Aid of Training Supervisors

Intermediate Frequency Stabilization by Engr-Sr Lt V. M. ZUYEV (Pages (Pages 54 - 59)

Text:

It is known that the ultrahigh frequency of a received reflected signal in superheterodyne receivers is transformed into a lower intermediate frequency (f_{pr}) which is amplified by an i-f amplifier. This amplifier will operate with maximum gain only when a constant i-f voltage is supplied to its input, i.e., the generator in the transmitter and the heterodyne in the receiver give stable frequencies which are not variable according to time. However, the practical achievement of this is difficult since climatic conditions, load characteristics, and power supply conditions vary.

One of the factors which influence changing load characteristics is the inexact performance of rotating connections. These defects lead to a change in the signal reflection coefficient in feeder lines during antenna rotation, and finally, to a change of the transformer frequency. The greater the speed of signal frequency change, the higher the transmitter carrier frequency and speed of antenna rotation. It might be changed so strongly that it leaves the receiver transmission band and stops signal reception. In those cases when the carrier frequency is changed within the limits of the transmission band of the radio reception apparatus, the sensitivity and shape of the emitted signal are deteriora deteriorated, the gain coefficient is decreased, signal delay time is increased, and errors in range determination are increased.

In order to preserve the most favorable reception conditions and to sustain a constant value of f_{pr}, it is necessary according to the amount of frequency deviation to tune it in such a way that the generator and heterodyne frequency difference does not fluctuate.

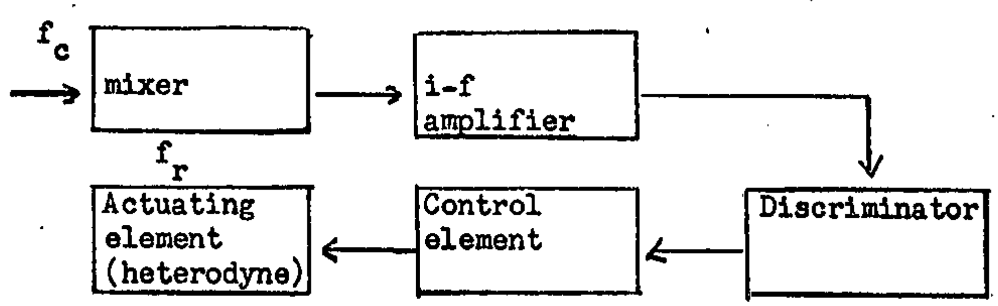

Figure 1.

It is not possible to provide a constant value of i-f by hand tuning since no operator can observe all of the frequency resonance shifts of a receiver. Therefore the generally accepted method of f_{pr} stabilization is automatic frequency congrol (APCh) [AFC] which maintains i-f stability during both slow and rapid transmitter and heterodyne frequency fluctuations.

Usually, an AFC system (figure 1) is in the form of the following system which produces an erroneous signal proportional to the deviation of i-f from its nominal value. An AFC circuit operates in the following manner. Signal and heterodyne voltage is transmitted to a mixer input where i-f voltages are generated. After amplification in the cascades of the [i-f amplifier], f_{pr} is fed to the discriminator, at the output of which voltage appears during f_{pr} deviation from nominal value. Having acted on the control element, it corrects the heterodyne frequency.

AFC is divided into two aspects according to operation of the systems: systems of difference and absolute frequencies. In circuits of the first type, a constant frequency difference is maintained (f_c to f_r or f_r to f_c), and in circuits of the second type, tuning of the receiver is automatically maintained on one frequence regardless of the frequency of received signals.

AFC is divided into search and follow systems according to the operation characteristics of the apparatus. Follow systems can tune a frequency accurately within sufficiently wide limits only when the speed of transmitter or heterodyne frequency deviation is less than the speed of system response. If this speed is greater, the apparatus can maintain tuning only during frequency shifts within comparatively narrow limits. AFC search systems are free of the shortcoming pointed out above.

Let us examine the operation and tuning characteristics of the basic elements of an AFC system. We begin with the reflex klystron.

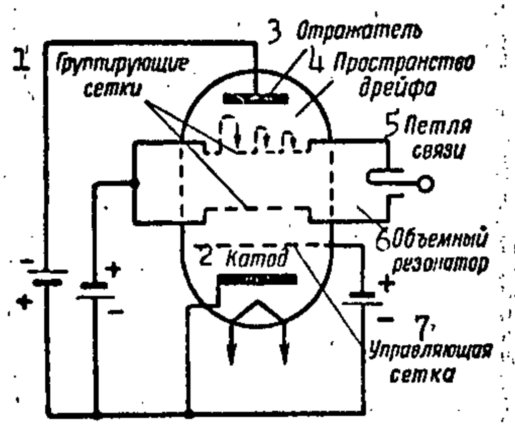

Рис. 2.

Figure 2.

1. buncher grids; 2. cathode; 3. repeller; 4. drift space; 5. loop coupler; 6. cavity resonator; 7. control grid.

A circuit diagram of a reflex klystron is shown in figure 2. Its operation principle consists of the following. Electrons radiated from the cathode move to the accelerating electrode under the influence of the constant accelerating field. From there with equal speeds in a uniform flow they enter the space between the resonator grids where there is a high frequency field. Under the influence of this field the electrons change the speed of their movement, i.e., their flow in the gap between the grids is modulated according to speed (figure 3).

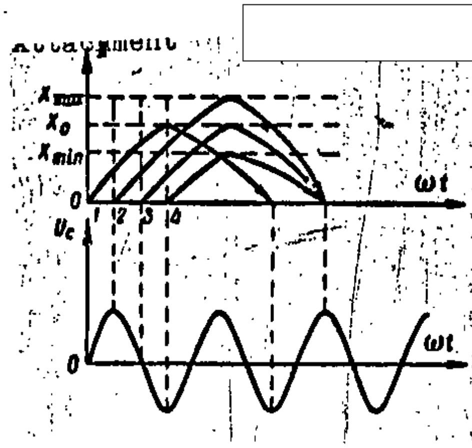

Figure 3.

The electrons which are passing the resonator grid in that half-period when the highfrequency field retards them are slowed down, but those which pass in the other half-period are speeded up. The electrons which pass the resonator at the moment when the highfrequency voltage is changing its sign pass the resonator with their speed unaltered. Leaving the resonator, they go to the constant repelling field of the repeller, under the influence of which their movement is at first retarded and then changed and they are returned to the resonator.

During the movement of the electrons from the resonator to the repeller and back, they are joined in groups around the electrons which did not change speed while passing through the resonator grid. Consequently, the modulation of the electron flow according to speed is converted to modulation according to density. If the time of electron travel between the resonator and the repeller allows the bunched electrons to return to their original condition at the moment of the appearance of the retarding high-frequency field, they return the energy to this field and in this way support oscillation in the klystron. Selection of electron travel time is achieved by changing the voltage on the accelerating electrode and at the repeller.

Thus, changing the electron travel time can cause electron bunches to arrive earlier or later and in that way the frequency of the generated oscillations is changed. It has been practically determined that maximum speed of electron tuning is achieved at the klystron repeller. Therefore signal errors usually occur at this electrode.

Changing of the frequency during voltage change at the klystron repeller is graphically portrayed in figure 4. It is evident from the drawing that increasing the absolute value of negative voltage at the klystron repeller decreases the travel time, which consequently evokes an increase in frequency oscillation. Decreasing this voltage leads to a decrease in frequency oscillation.

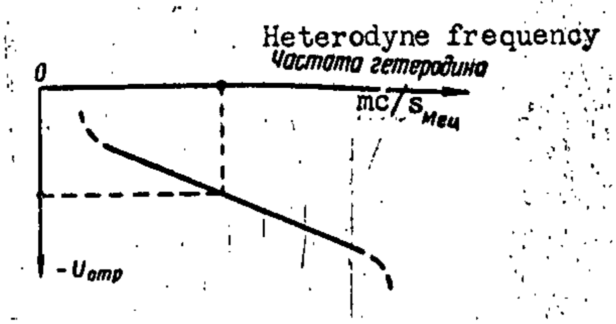

Figure 4.

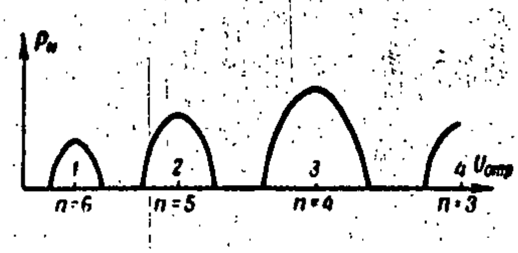

Figure 5.

It must be remembered that a reflex klystron has sever distinct regions of klystron generation (activation) (figure 5). The number of generation zones is varied for different types of klystrons. The klystron operates in the most stable manner at points 1, 2, 3, and 4.

The next element of the system is the discriminator. Its purpose is to "trap" i-f deviations from the assigned value and to produce mismatch voltages depending upon the intensity and sign of this deviation. It has been determined that the best operation characteristics are those of discriminators with two detuned circuits. A line diagram of a discriminator is shown in figure 6.

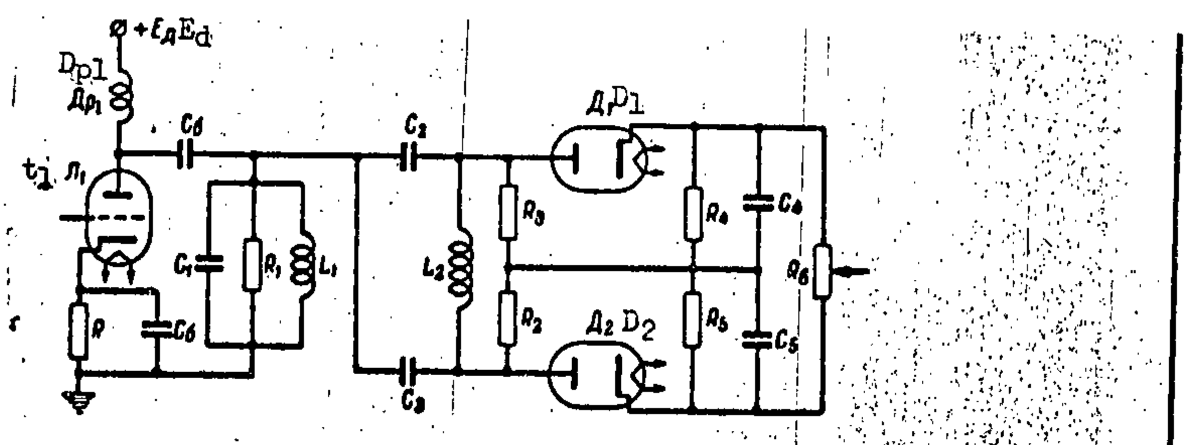

Рис. 6

Figure 6.

Capacitors C_2 and C_3 with inductance L_2, and the diode and wiring capacitance constitute two series circuits with different self-resonant frequencies. Resistance R_4 is the load for the upper diodes and R_5 for the lower diodes. The values of R_2 and R_3 are chosen in such a way that the necessary transmission band is achieved.

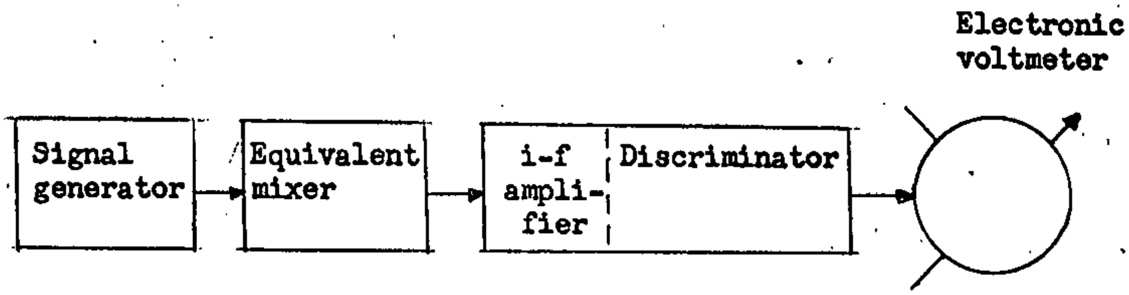

Figure 7.

The operating principle of a discriminator consists of the following. The i-f signal is detected by diodes D_1 and D_2 and the voltage difference achieved by this is taken from the loads. One diode detects the signals in the circuit with the difference frequency f_1 and the other with the difference frequency f_2. Because of this, emitted voltages which have amplitude and polarity dependent upon the frequency relationships of the passing signal and the discriminator crossover frequency are created at R_4 and R_5. The voltage difference produces an error signal (SO) which appears as a videopulse of "positive" or "negative" polarity. If f_{pr} is equal to the crossover, both circuits have similar detuning. A similar voltage acts at the diode anodes giving equal rectified currents. The error signal in this case is equal to zero.

Precise operation of an AFC system depends very much on normal discriminator operation. Therefore, its adjustment must be carried out with instruments and an oscillograph together with the tuning of the system i-f amplifier. Use of the oscillograph is the most convenient for preliminary discriminator tuning, since the discriminator curves can be observed on the oscillograph screen which allows the correctness of the tuning to be approximately determined. Final tuning and determination of the discriminator parameters is done according to the diagram shown in figure 7. This is the sequence for carrying out the operation. At first, the signal-generator and the electronic voltmeter are warmed up and the electronic voltmeter is set at zero. Then the discriminator curves are plotted $U_d = (f)$ while U_{vx} = const. For this, the signal-generator is tuned to a frequency which is at a distance from intermediate approximately the width of the discriminator characteristic. When the signal-generator frequency is moved 1 mc/s toward f_{pr}, electronic voltmeter readings which correspond to the frequency difference are recorded. In this way, the maximum and minimum discriminator curves and also/the crossover curve through zero are very carefully determined. The discriminator characteristic is plotted according to chosen points (figure 8), and its parameters are determined from the plotted curve; the amplification coefficient of the i-f amplifier and the discriminator are determined by the formula

$$K_{AFC} = \frac{U_{discr} \, 10^3}{U_{vx} \cdot K_{o \cdot e}}$$

where U_{discr} is voltage in volts indicated on the electronic voltmeter and equal to the smaller of the amplitudes U_1 and U_2;

U_{vx} is input voltage in millivolts indicated on the signal-generator attenuator;

$K_{o \cdot e}$ is reduction in the mixer and cable connection equivalent. Depending on the parameter, the equivalent of intensity of reduction is altered within the limits of 0.2 to 0.3.

If the achieved discriminator parameter values do not correspond to requirements, it is necessary to align the i-f amplifier cascades and discriminator circuits. Double diode or crystal diode electron tubes are used for discriminator diodes.

Let us consider the essence of the operation and adjustment of the AFC system control element. The purpose of this element is to change the voltage at the reflex klystron depending on the error signal voltage produced by the discriminator. As a result of this, the heterodyne frequency is brought near to its nominal value. Search diode-transitron control circuits can be used for the control element. A block diagram is shown in figure 9 and a line diagram is shown in figure 10.

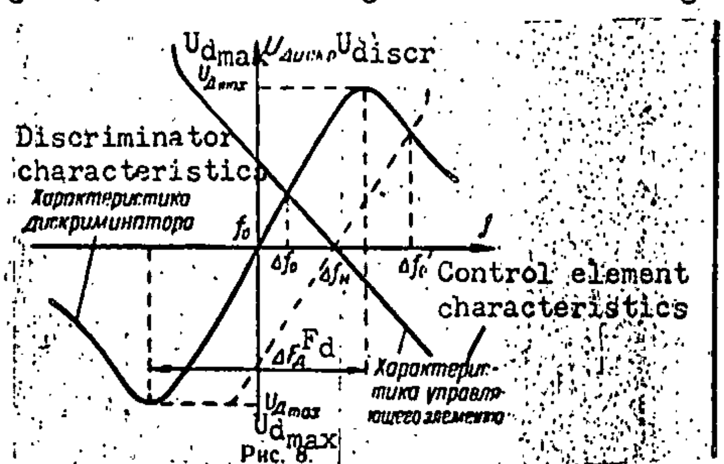

Figure 8.

S-E-C-R-E-T

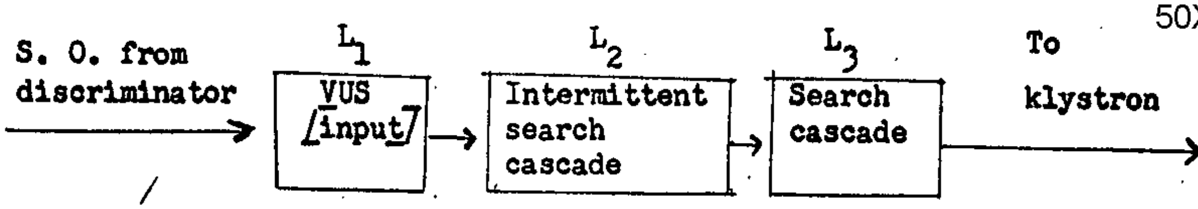

Figure 9.

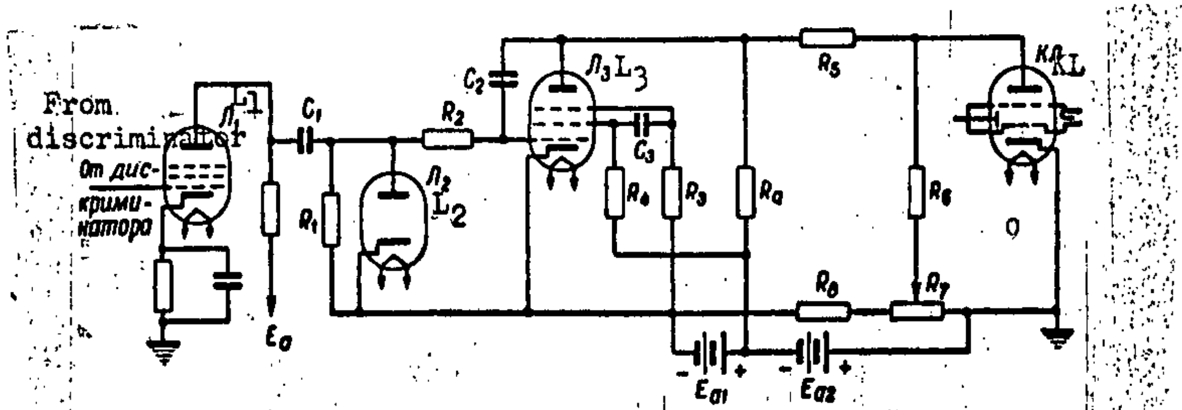

Рис. 10.

Figure 10.

In this circuit, the search cascade creates sawtooth voltage which is supplied to the reflex klystron. The sawtooth changes of klystron frequency evoke periodic adjustment of the receiver and then lead to the appearance of voltage videopulses at the discriminator output. After amplification, this voltage goes to the intermittent search cascade which usually is done in such a way that it produces intermittent search voltage only at that moment when the heterodyne frequency has an intensity which produces an intermediate frequency close to f_o.

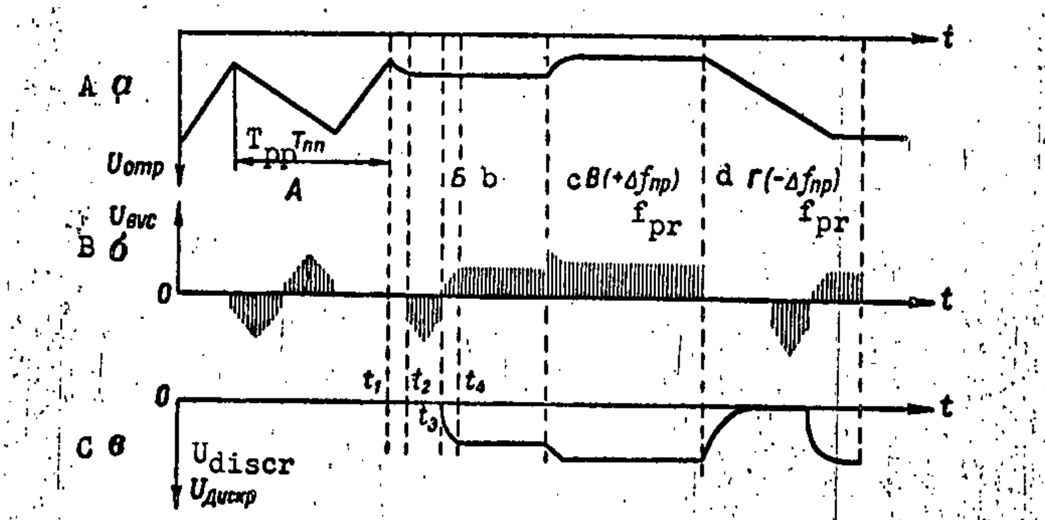

Рис. 11.

Figure 11.

The problem of intermittent search is resolved in the following manner (figure 11). Until the transmitter is turned on (until t_1), the transitron generator continually generates sawtooth voltage. As a result the heterodyne frequency is altered within a wide search range with the repetition period T_{pp}. After the transmitter is turned on (t_1), the negative voltage at the reflex klystron, as is evident from figure 11, is insignificant and therefore the heterodyne frequency is small. As long as the difference frequency is far smaller than the crossover, there are no video pulses at the control circuit input (figure 11 b) and the circuit continues to search. Further increase of negative voltage at the reflex klystron (figure 11 a) increases the heterodyne frequency and at moment t_2 the difference frequency enters the i-f amplifier transmission band of the AFC system. Then, a video pulse of positive polarity appears at the discriminator output and a video pulse of negative polarity appears at the video amplifier output which has no essential effect on the operation of the control circuit.

At moment t_3, difference voltage reaches crossover value and then slightly exceeds it. In this case, video pulses of negative polarity appear at the discriminator output and video pulses of positive polarity appear at the video amplifier. The latter go to diode (L_2), are detected, and create negative voltage at resistance R_1 which is connected to the grid circuit of tube L_3. At a determined intensity, the decrease of negative voltage at grid L_3 is stopped due to the discharge of capacitor C_2.

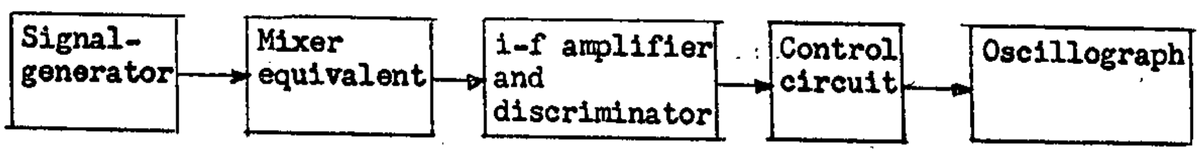

Figure 12.

At moment t_4, the voltage at grid L_3 is no longer changed and consequently transposes to changing the anode voltage and at the same time the voltage at the reflex klystron. Consequently, from this moment, the AFC circuit switches from a search regime to a tracking regime. Then the control cascade begins to operate like an UPT /direct-current amplifier/.

Adjustment of the control circuit includes three operations. The first consists of establishing the required sawtooth voltage frequency. Small frequencies can be measured in practice by an oscillograph according to the number of oscillation periods during a period of time which can be recorded by means of a stop watch. Measurement of large frequencies is usually accomplished by an oscillograph and an audio-frequency generator by a pulsation method. Changing frequencies of sawtooth oscillations are produced by capacitance C_2. The second operation consists of checking the amplitude of the sawtooth oscillations. Its measurement is best carried out with an oscillograph with an input calibrated in units of voltage. In the third operation the ability of the control circuit to change over from the search regime to the tracking regime under the influence of a signal at the AFC block input is checked. The check is carried out according to the circuit and in the sequence shown in figure 12. First, the signal-generator frequency is changed in such a way that it lies beyond the limits of the discriminator curve. The signal-generator attenuator must be exposed. The periodic sawtooth oscillations are observed in the given case on the oscillograph screen. With this, the signal-generator frequency is smoothly changed in the direction of the intermediate frequency.

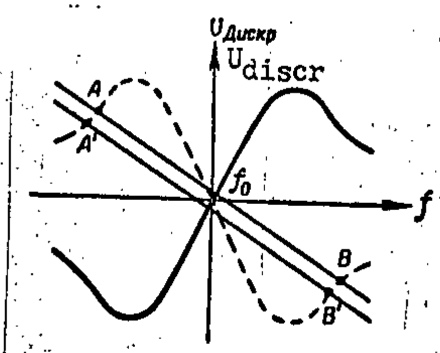

Рис. 13.

Figure 13.

As soon as the signal-generator frequency falls into the region of the peak which conforms to the discriminator characteristic curve, the control circuit changes from the generation regime to the amplification regime. The transfer can be observed on the oscillograph screen by the disappearance of the sawtooth oscillations. When the emitted signal-generator voltage has been decreased, the control circuit can again be changed into the generation regime. By smoothly tuning the frequency and the emitted signal-generator voltage, that minimum voltage at the input of the AFC system can be located at which system operation begins. The intensity of this voltage characterizes the sensitivity of the AFC circuit. Now the adjustment of the AFC system can be considered completed.

One should constantly remember that for normal operation of the AFC system, the heterodyne frequency must be established first. It may be either higher or lower than the transmitter frequency.

The receiver will operate normally in either case, but it makes a difference in the AFC operation. Integration of the discriminator characteristic with the electron tuning curve for those occasions when f_r is greater than f_c is shown in figure 8 (solid line) and for those times when f_r is smaller than f_c in figure 13. It is evident from these drawings that the most stable points of the AFC system will be points AA' or BB', i.e., the system will retain a constant separation for more than half of the discriminator band.

Entrance of the system at the stable point A or B depends on the initial conditions at the moment of turning it on. Transfer from spurious operation to normal with the preservation of the previous heterodyne frequency value can be accomplished by changing the voltage polarity at the discriminator output. Consequently, the discriminator characteristic will be a continuous line (see figure 13) and the AFC system will begin to operate normally.

In this manner, a radar receiver must have a high tuning stability during operation. It can be achieved only through normal operation of the AFC system, which in turn depends on correct adjustment and maintenance.

<u>Sum Circuit by Resistance</u> -- by Engr-Capt Ye. G. DULEPOV (Page 59)

Text:

For exact matching according to time of two voltages U_1 and U_2, it is often necessary to observe both of them simultaneously on an oscillograph. However, many of these, for example the SI-1, do not allow this since they have only one input. Therefore, it is necessary to resort to a sum circuit by resistance (figure 1). This allows the oscillograms of U_1 and U_2 to be observed separately and their components to be discerned by consideration of the oscillogram of the total voltage of U_{out} (figure 2).

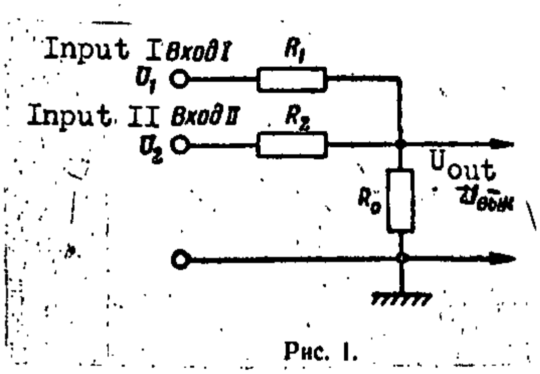

Рис. 1.

Figure 1.

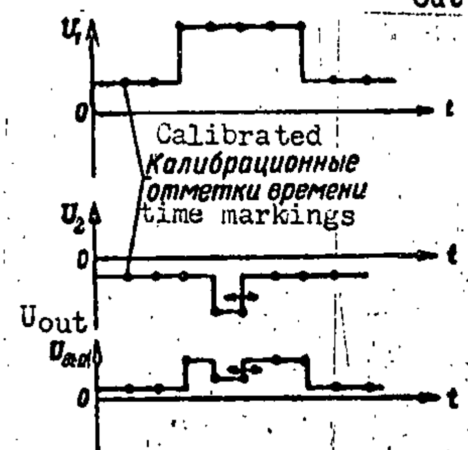

Figure 2. Рис. 2.

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In order to eliminate the reciprocal influence of inputs I and II on each other, R_1 and R_2 must be selected on the order of several hundred kilohms and R_o on the order of several units or tens of kilohms. In this case, R_o is smaller than Ri (i = 1.2). Since R_o is usually smaller than r at the oscillograph input, the sum circuit practically do does not distort the input signal.

A similar circuit can be used for simultaneous observation on an oscillograph of three and more voltages. A sum circuit can be installed directly in a single-channel oscillograph which expands the possibilities for its use.

<u>New Performance Requirements for Jet Fuel</u> -- by Engr-Lt Col A. P. GRYAZNOV and Engr-Lt Col B. G. CHERNYKH (Pages 60 - 62)

Text:

The increased flight altitudes and speeds of modern aircraft have essentially changed the operation conditions of many flight systems, equipment, and power plants, including engine fuel regulation equipment. One of the basic factors determined by the changing of these conditions is the significant increase in the temperature of the fuel which is supplied to fuel system assemblies. The temperature of the fuel from the fuel-oil radiator of the power plants of contemporary fighter-aircraft reaches 100 degrees and more.

This increase of temperature occurs both as a result of the fuel heating in the aircraft tanks during continued flight at high altitude and due to heating in the fuel-oil radiators which are usually placed in the main line of low pressure, i.e., on the supply feed to the main engine fuel supply assemblies.

The increase of temperature has required the solution of many problems connected with ensuring the stability of parameters and characteristics of fuel regulating assemblies and with providing reliable operation of their most heavily loaded components, in particular the preequipping of the most critical assembly components with heat-compensating liquids or making them of bimetallic construction. Besides this, reliable fuel equipment operation has required the invention of many new heatproof materials. This is concerned primarily with rubber and nonmetallic materials which are widely used for gaskets, membranes of sensitive equipment, cups for servoinstruments, etc.

Reliability of operation and the service live of fuel regulating equipment have specified new performance requirements for jet fuel. What are these requirements?

[redacted]

Under the influence of high temperatures, important chemical changes can occur in fuel upon contact with the metals which are used in the construction of fuel equipment: oxidation with the formation of resinous substances and solid insoluble sediments. The causes of the formation of such sediments are various impurities of oxygen, sulfurous, and nitrogenous compounds, and also compounds containing metals. All of them as a rule, are present in petroleum fuels and have low thermal stability. Although the content of these impurities in fuel is very small, not exceeding several tenths of one percent, it is namely they which cause performance difficulties.

With heating of fuel, there also occurs a change of its qualities due to oxidation of unstable hydrocarbons in the fuel, which leads to the formation of acidity and the conservation of resin in the fuel. The formation of resinous substances and solid insoluble sediments in the fuel filter elements when they precipitate on details and components of the fuel equipment, bring about interruption of fuel equipment control, and cause sticking and jamming of plunger elements which in the final count leads to interruption of normal operation of the aircraft engine. Change of the physical and chemical properties of a fuel with temperature increase is shown in figure 1.

Investigation of the fuel which is currently used for turbojet engines has shown that when it is heated to 100 to 130 degrees Centigrade with air present in it, the formation of sediments which clog system filters begins. The temperature where the formation of sediments begins is the tolerable limit for the use of the given fuel. The dependence of the speed of filter clogging by sediments on temperature is shown in figure 2.

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R E T
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Attachment

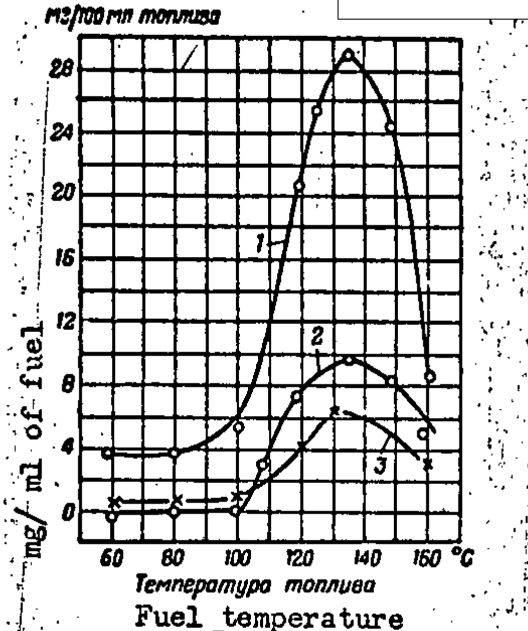

Рис. 1.
1 — содержание смол; 2 — содержание осадков. 3— кислотность.

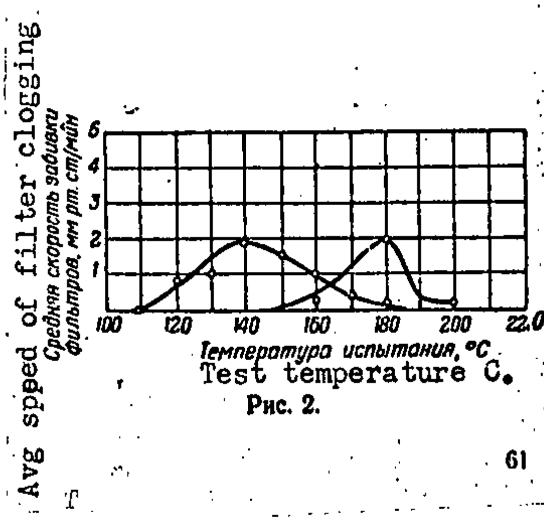

Рис. 2.

61

Figure 1.

Figure 2.

1. Resin content; 2. sediment content; 3. acidity

However, it is also necessary to consider that the influence of many performance factors affect the thermal stability of fuel. If, for example, water is present in the fuel, its filtration is impaired. This occurs because the products of fuel oxidation, i.e. resins, when combined with drops of water, cause cohesion which causes them to adhere to each other and forms a film on the filter.

The presence of mechanical particles or of impurities in fuel during the formation of resinous substances leads to the consolidation of these particles so that they become quite large, which might not only cause plugging of the filter pores, but can also lead to the sticking of the plunger elements of the fuel equipment. Therefore, fuel for supersonic aircraft must be especially carefully filtereddduring refueling and it must be carefully checked in order to detect the appearance of impurities or of water.

It must be remembered that fuel that has been subjected to a prolonged period of storage has a lower thermal stability than fresh fuel. The deterioration of that stability is best shown by the decrease in the temperature where sediment begins to form.

Increase of thermal stability of fuel is achieved by using supplemental chemical means of purification which allow the removal of nonhydrocarbon impurities from the fuel. An economically useful and effective means of increasing the thermal stability of fuel is to add a small quantity of special additives to it. The additives decrease the corrosive influence of the fuel on the metal of the fuel equipment, prevent the consolidation of sediment particles, and decompose formations of consolidated sediment.

The lubricating qualities of fuel are of great importance to operation. As is known, in most engine fuel-feed and fuel-control equipment, the fuel is not only a working element, it is also a lubricating agent. In many details and components, the wear and tear of operating parts is insignificant. However, in supporting coupling members it can be quite significant. Thus, the large operation sphere of pump plungers enables burrs to form on the plunger surfaces and brings about chipping which can lead to the jamming of the plunger in the rotor and to the breakdown of the fuel regulating equipment component. Increasing the wear along the bearing band race of the inclined fuel pump plate causes fluctuation in engine revolutions which are higher than the norm of technical conditions and are not allowable. It is also possible to increase wear and tear in a component of the regulator centrifugal pickup which causes variations in the revolutions of the automatic regulator and decreases maximum RPM.

Existing methods of determining the physical and chemical qualities of fuel do not always allow determination of its lubricating qualities. Therefore, the antiabrasive quality of a fuel is ofteneevaluated by means of a friction machine on which, according to a special program, a load intensity is set up at the location of working part contact (P_k) which causes a rib to be formed on the surface. The higher the P_k, the better the antiabrasive quality of the fuel. Operation experience has shown that fuel equipment has the least wear when T-1 GOST 4138-49 fuel is used. It has the greatest wear with T-2 GOST 8410-57 fuel. TS-1 GOST 7149-54 fuel occupies an intermediate position in this relationship.

The wear and tear of equipment is significantly increased with increase of fuel temperature. Consequently, there is a need to improve its lubricating capability so that it has fine antiabrasive qualities within a wide temperature range. This can be achieved by adding special additives to the fuel, which by covering the working surfaces of working parts with a thin film significantly decrease their wear and tear. It is important that this additive does not deteriorate any other fuel qualities and that it does not bring about operational difficulties.

An essential influence on the operation capability of fuel regulating equipment is the degree of fuel contamination by various mechanical impurities. We notice that the fuel systems of aircraft with turbojet engines are more sensitive to fuel contamination than the fuel systems of aircraft with piston engines. This is explained by the intricacy of their construction and the small tolerances allowed between operating components. It is also necessary to have in mind that turbojet engines consume a significant quality of fuel during flight. Therefore, the presence of even a small quantity of mechanical particles in the fuel has a significant effect on the operational quality of the fuel equipment.

Mechanical particles can enter the fuel during open refueling of the aircraft on the parking stand. Minute slag particles which are products of corrosion in the tanks and tubing used for storing and transfer of fuel until the aircraft is refueled, can also appear. These minute slag particles enter the fuel through poor checking of the condition of the fuel tank park at the airfield and also because of poor filtration of the fuel at the airfield before the aircraft is refueled.

Thus, regarding fuels for aircraft with supersonic speeds and high altitude characteristics, there is need not only for special requirements related to their chemical qualities, thermal stability, and antiabrasive qualities, but there are also special requirements for observation of the rules and schedules for fuel preservation, careful filtration, and strict observance of all aircraft refueling rules. There should also be an attentive approach to aircraft fuel filter systems. All of this will allow a significant increase in operation reliability and service time of fuel-regulating and fuel-feeding equipment and, as a result, of turbojet engines.

Better knowledge on the part of flight and engineer-technical personnel of the qualities of aviation fuel and the problems which it presents will enable the best operation of modern aircraft and the maximum use of their combat capabilities.

<u>Electric Equipment for Constant Power Supply</u> -- by Engr-Lt Col I. A. YEMEL'YANOV and Engr-Lt Col I. K. ISAKOV (Pages 63 - 64)

Abstract:

Based on foreign press, discusses constant-current power supply equipment for radar complexes, computer devices, etc.

No Foreign Dissem

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Innovations and Inventions

Remote Control of Lighting Equipment -- by Lt Col N. V. NIKONOV (Pages 65 - 66)

Abstract:
Describes construction of a remote-control system for airfield lighting which has been successfully used in the author's unit for two years. The system allows the flight controller to have direct control of all necessary airfield lighting including the capability to blackout the entire field and requires only one electric power plant manned by a single crew. Figure 1 shows the control panel circuit and figure 2 shows the circuit of the lighting system.

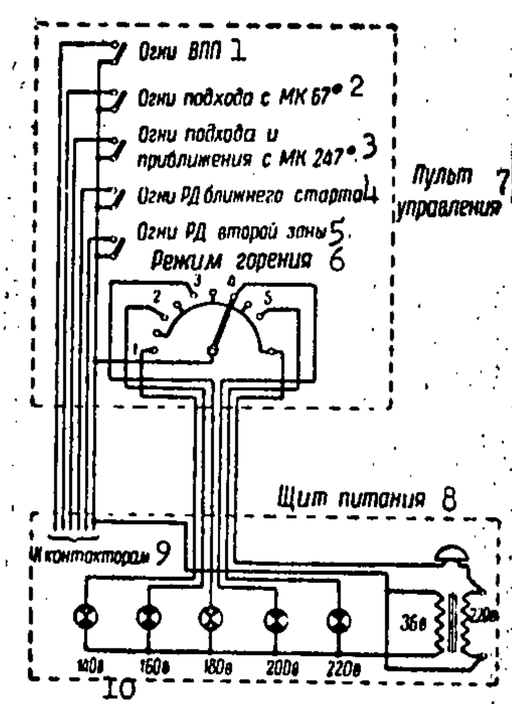

Рис. 1.

Figure 1. 1. Runway lights; 2. Approach lights for 67-degree heading; 3. Approach lights for 247-degree heading; 4. Take-off taxi strip lights; 5. Second zone taxi strip lights; 6. Illumination regime; 7. Control panel; 8. Power supply board; 9. to switches; 10. 140 volts, 160 volts, etc.

S-E-C-R-E-T

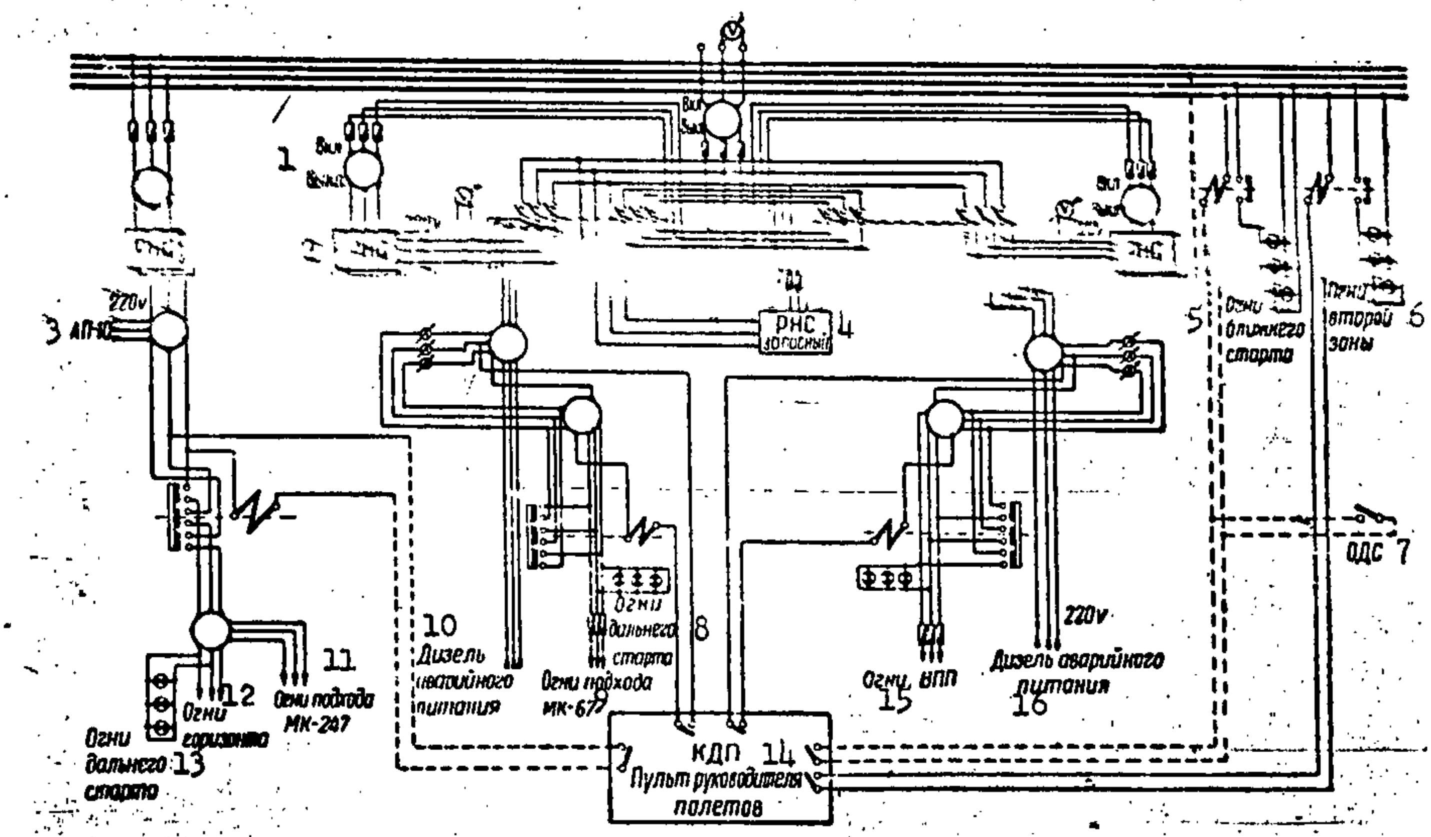

Рис. 2.

Figure 2. 1. Vkl [on[Vykl [off]; RNS [radionavigational station or type of transformer?]; 3. AP-10; 4. reserve RNS; 5. Take-off approach lights; 6. Second zone lights; 7. ODS; 8. Distant take-off lights; 9. 67-degree heading approach lights; 10. Standby power supply diesel; 11. 247-degree heading approach lights; 12. Horizon lights; 13. Distant take-off lights; 14. KDP [air traffic control tower] flight controller panel; 15. VPP [runway] lights.

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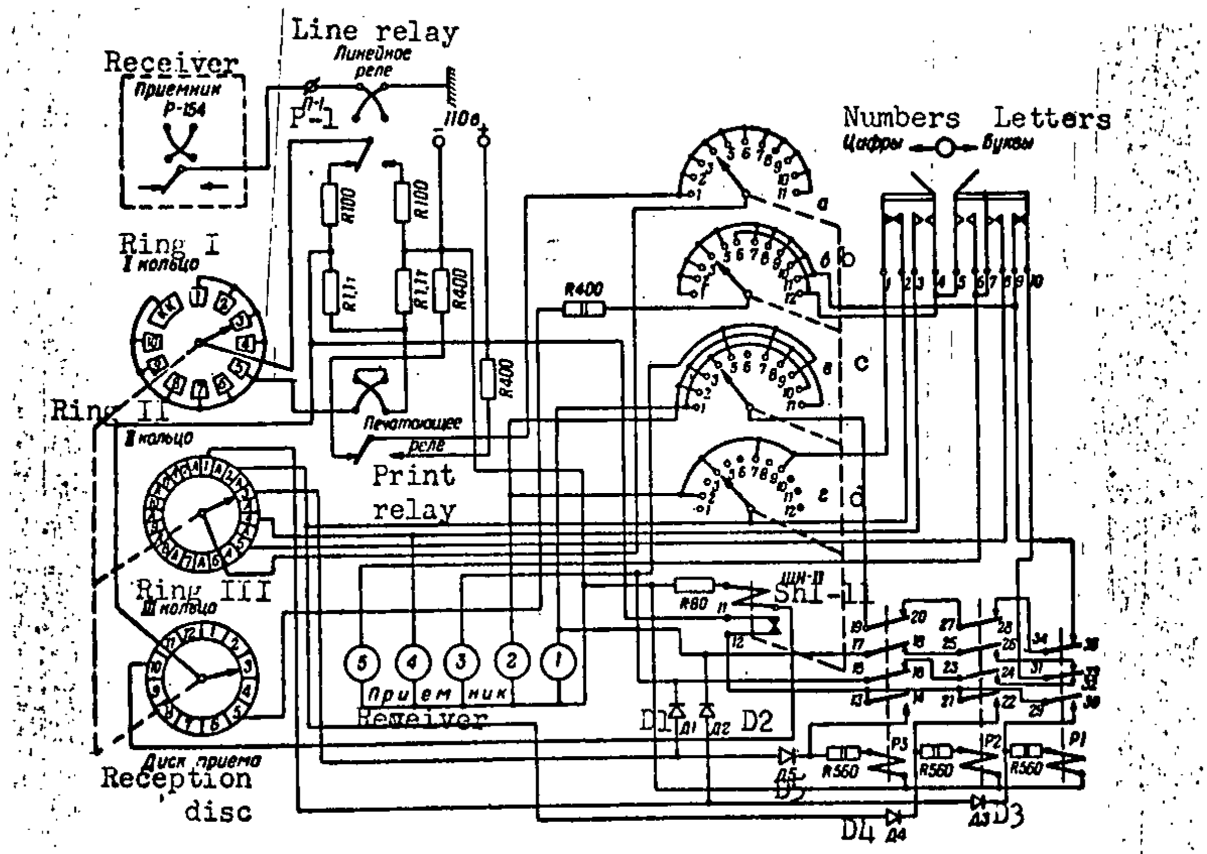
An Instrument for Composing Texts for Training Radiograms -- by Maj Tech Serv V. F. SMIRONOV (Pages 67 - 68)

Text:

In order to provide a normal training process and also to conduct systematic training in printer circuits, it is necessary to prepare a large quantity of training radiogram texts in advance. Choosing them by indiscriminate means is accompanied by a great expenditure of time and labor. To escape this, an instrument might be used which enables the automatic printing of texts on telegraph tape. With this, the numbers of letters can be in groups of five with intervals between groups.



As is evident from the circuit shown in the drawing, the instrument is an adapter to a Baudot telegraph apparatus which uses only a reception disk. At terminal P-1 a series of unordered impulses of positive or negative polarity are supplied from the relay of P-154 [R-154] radioreceiver (or the Amur-2) which is placed in a printer regime and tuned to the noise of any sort of signal. These pulses follow further along the circuit of the Baudot apparatus through the line relay and the contacts of the first ring on the print relay winding. Then through contact blank "a" of the step-by-step switch in all of its positions except the sixth and twelfth, the pulses are supplied through the fifth ring to the contact of the second distributor ring.

To print a letter text, the switch is placed in the "Letters" position and the step-by-step switch in position "1". Suppose that in the first distributor revolution, the positive pulse chain falls on contacts 1, 3, and 4 of the second ring; during the second, on contacts 1 and 5; during the third, on the fourth; during the fourth, on the fifth; during the fifth, it generally does not meet any contact; and during the sixth, on all five contacts.

Proceeding from the given condition, during the first revolution from the second ring (through the fifth ring) from contact 1 through diode D2, the impulse current causes the first electromagnet of the telegraph apparatus receiver to operate; and through diode D_3 and the resistance, the current causes operation of relay P-1 [R-1] which is selfblocking through contacts 11-12 and 29-30. Then, from the third contact of the second ring through diode D_1, the third electromagnet of the receiver starts to operate due to the pulse current and through diode D_5 and the resistance, relay P3 begins to operate. Relay P3 is also selfblocking through contacts 11-12 and 13-14. After this, through the fourth contact of the second ring, the current causes operation of the fourth electromagnet of the receiver. With further rotation of the brush over the second ring, the current pulses will not be supplied to the circuit and the selector starts to print the prepared combination 1+3+4, i. e., the letter "o".

When the distributor reaches the tenth contact, the step-by-step switch starts to operate on the third ring. It is switched into position "2" and the relay, selfblocked by contacts 11-12, returns to the original position.

During the second revolution, the first receiver electromagnet begins to operate according to the analogy noted above, the fifth electromagnet begins to operate through contacts 7-8, and the combination 1+5 (the letter "ch") is printed. Then the switch is switched to position 3 and the relay is blocked.

During the third revolution, the pulse is supplied only to the fourth contact of the second ring and consequently to the fourth receiver electromagnet. But such a combination indicates that the receiver is transferred to the number register. To prevent this, the contact blank "c" current pulse is supplied to the second electromagnet of the receiver from the fifth contact of the third ring through resistance R_1, contact blank "b", contacts 34-35, 27-28, and 19-20. As a result, the combination 2+4, i. e., the letter "g" is printed.

During the fourth revolution of the distributor, in conformance with the earlier accepted conditions, the current pulse will be at only the one-five contact of the second ring. This combination, as is known, is a problem in a letter text. But since the current supplied from the fifth contact of the third ring starts operation of the first electromagnet of the receiver; the combination 1+5, the letter "ch", is printed instead of an interval.

During the fifth revolution of the distributor on the second ring, according to the conditions, there will be no pulse chain. Therefore the given combination will not extend to the tape on the receiver. To correct this, the current pulse is supplied along the ealrier mentioned circuit from the same fifth contact of the third electromagnet of the receiver and the letter "i" is printed.

During the sixth revolution, the circuit of the second ring of the distributor is broken by the contact blank "a" of the selector and no current pulse is supplied from this ring to any electromagnet. But a pulse arrives at the fifth electromagnet from the fifth contact of the third ring through R_1, contact blank "b", and contacts 5-6; and an interval appears on the tape.

During the next five revolutions of the distributor, depending upon whether the current pulse chain combinations, which are supplied from the relay of the radioreceiver, are positive or negative, five new letters are printed; and with the sixth revolution, an interval is registered. Since the combination of radioreceiver pulse chains is composed of noise or random signals, there is little possibility of repeating groups.

During the printing of a numbered text, the fifth electromagnet is disconnected by contrasts 5-6 and 7-8 so that it takes no part in the selection process. Sixteen combinations can be chosen out of the remaining four electromagnets. From these, ten combinations compose ten numbered characters, one combination (the fourth electromagnet) causes intervals between groups, and five combinations (1+2, 1+2+4, 2+3, 2+3+4, and the combination during which none of the four electromagnets operate) which must be excluded from the text.

Suppose that during the first revolution of the distributor, the combination 1+2 is received from the second ring; during the second revolution, the combination 1+2+4; during the third, 2+3; during the fourth, 2+3+4, and during the fifth, there is no pulse chain. In this case, only the first electromagnet will operate during the first revolution since the circuit will be disconnected at the contact blank "c". During the second revolution, besides the first, second, and fourth electromagnets; the current through R_1, blank "b", contacts 9-10, 31-32, 23-24, and 15-16 will also cause operation of the third electromagnet of the receiver and the number "0" will be printed.

During the third revolution, only the third electromagnet operates since the circuit of the second is broken by blank "c". In the next revolution, the first electromagnet will be added to the combination 2+3+4 and the number "0" will be printed again. During the fifth random revolution, in analogy to letter printing, the third electromagnet operates. If the combinations 1+2 and 2+3 are derived at the selector position when the second electromagnet is not disconnected, the third electromagnet would be added to the first combination and the first electromagnet would be added to the second. In both cases, the number "5" would be printed.

At the sixth and twelfth positions of the step-by-step switch, the current pulse will go only to the fourth electromagnet of the receiver and an interval between the groups will be recorded.

The described instrument has been used for a long time in our chast' and has shown positive results. It can be manufactured by any military workshop. RKM-2 relays have been used for it, but any others with conforming contact groups can be used. All diodes are of the type D-7-V. The remaining details are shown in the diagram.

Switchboard and Concentrator Checking Device -- by Capt K. V. DOROSHIN (Pages 69 - 70)

Text:

In testing or checking switchboards and concentrators with a capacitance of from 10 to 100 there is usually much time involved in switching from one subscriber's assembly to another and also in testing junction cables by signal test of each core and line with a circuit tester or ohmeter. In order to reduce the expenditure of time it is suggested that an instrument be used for the semiautomatic checking of switchboard subscribers' assemblies and also for the automatic checking of junction cables for core breaks or short-circuiting between them.

The device is mounted in a wooden box measuring 270 by 180 by 140 millimeters. On its control panel are installed lamp caps for damage and indicator bulbs; starting buttons for the selector for changing speed, and for switching on a bell; an instrument toggle switch; a "cable-equipment" switch; and 30-contact terminal blocks. The circuit elements are arranged inside of the box.

RPN relays are used in the instrument circuit (see illustration). Five layers of bare copper wires with a diameter of 0.5 millimeters and 6,800 turns of PEL-1 wires with a diameter of 0.12 millimeters are coiled at the core of the pulsating relay (RP) which has a resistance of 600 ohms. In order to retard the operation of the relay, electrolytic capacitors of 20 and 200 microfarads are included in the circuit. The relay break (RO) has a resistance of 5 ohms. At its core coiled 1,000 turns of PEL-1 wire with a diameter of 0.44

millimeters. The short circuit relay (RK) with a resistance of 2 ohms has 580 turns of coiled PEL-1 wire with a diameter of 0.7 millimeters.

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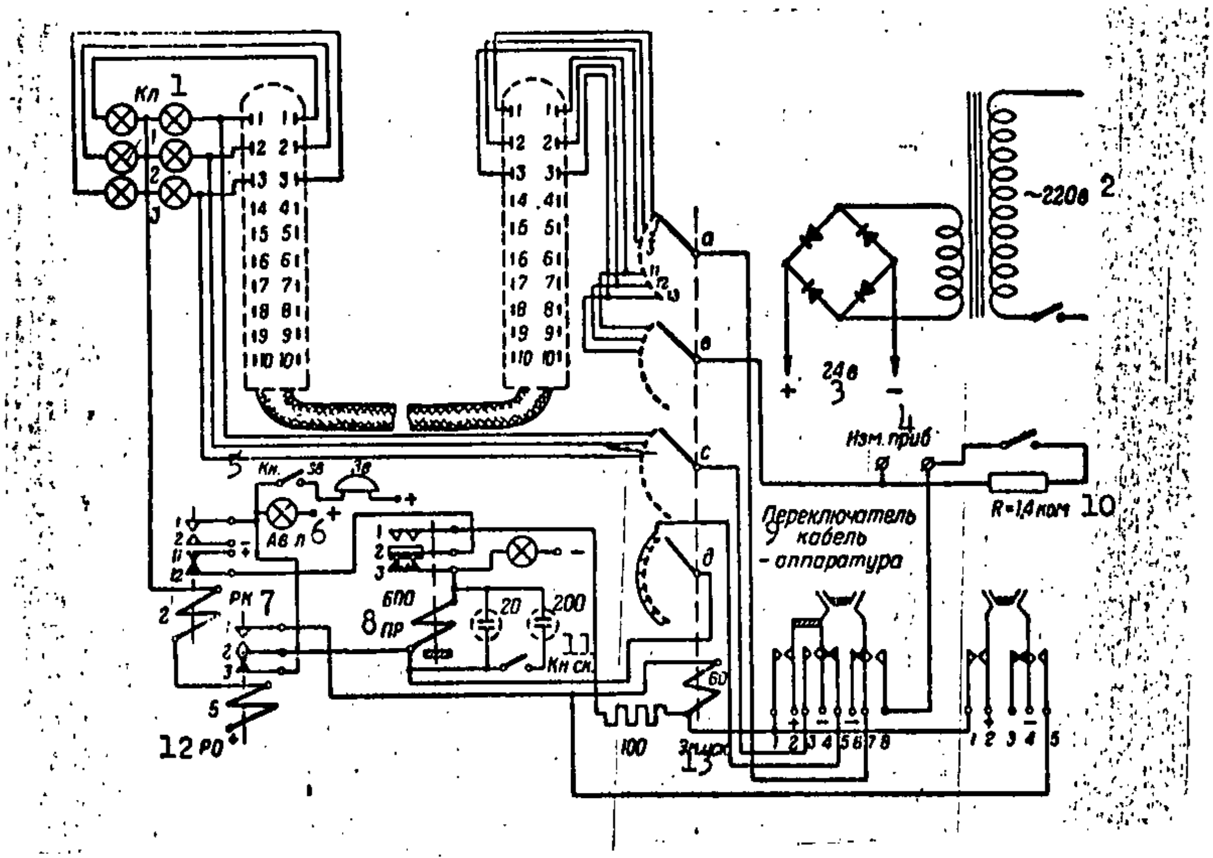

1. KL indicating lamp
2. 220 volts
3. 24 volts
4. measuring device
5. button
6. damage bulb
7. RK short circuit relay
8. PR pulsating relay
9. "Cable-equipment" switch
10. Resistance = 1.4 kilohms
11. speed button
12. relay break
13. Em magnetic clutch selector

S-E-C-R-E-T

The device is supplied with power from an alternating current circuit of 220 volts through a transformer and a rectifier. The transformer core with a thickness of 40 millimeters is constructed of Sh-20 iron plates. Its primary windings have 1,540 turns of PShO wire with a diameter of 0.41 millimeters. The secondary winding of the transformer has 190 turns of PEL-1 wire with a diameter of 0.8 millimeters. The sleenium rectifier is constructed according to a bridge circuit. Each arm has two washers with a diameter of 45 millimeters.

Checking of equipment by use of the device is done in the following manner. The first 30-contact block is connected to the conforming TSKV 10 by 2 cable block or through the adapter to semiplicing TTKV 5 by 2 cables with their opposite ends connected to the equipment to be tested. The "Cable-equipment" switch is placed in the "equipment" position. The ringing or speaking device or else the electric measuring instrument is connected to the "equipment" jacks. If the check concerns the TsB [common battery?] of the P-198 switchboard, only the "R-1.4 kilohm toggle is switched on.

Placing the toggle on the device in the "switched on" position supplies power. With this, circuit No. 1 is started: A positive terminal, RK contacts 11-12, PR contacts 2-3, and KL. The indicating lamp (KL) is illuminated. The device is started by pushing and releasing the "start" button. After it is pressed, the selector moves along circuit No. 2 and the next subscriver's assembly along circuit No. 3 is connected to the "equipment" jacks. The ordinal number of the assembly being tested sounds a signal along circuit No. 4. All of these circuits are composed of the following circuit elements: Circuit No. 2 - a positive terminal, start button contacts 2-1, EM [magnetic clutch] selector contacts 1-2, start button contacts 5-4, and a negative terminal, circuit No. 3 - jack 1, wiper "b", the right contact of the 30-contact block, the circuit of the equipment being tested, the left contact of the 30-contact block, wiper "a" of the selector, "Cable-equipment" switch contacts 7-8, jack 2, resistance R, toggle, and jack 1; circuit No. 4 - a negative terminal, "Cable-equipment" switch contacts 4-3, wiper "c" of the selector, EM, KL, RK, RO, and a positive terminal.

Checking of cable integrity is done in the following manner. Both 30-contact blocks of the device are connected to the cable being tested. The power supply of the device is switched on. Then by pushing and releasing the start button, circuit No. 2 is formed. With each push of the button, the selector wiper moves along the segements and circuits No. 5 and No. 6 are closed.

Circuit No. 5 is constructed as follows: a negative terminal, "Cable-equipment" switch contacts 6-7, selector wiper "a", the first contacts of the segment and the 30-contact block, the first contact of the other 30-contact block, indicating lamp KL, RK winding, RO winding, and a positive terminal. The RO relay operates inside of circuit No. 5. If the core of the cable is not in working order, spring 2 goes from the third contact to the first, having suppressed the negative terminal of the battery at the EM selector winding and the first indicating lamp is illuminated. With this, the RK relay does not operate since a current of 125 milliamperes is flowing along the circuit from the cable core and this, as is known, is insufficient for operation of this relay.

In circuit No. 6, which is composed of a positive terminal, RK contacts 11-12, PR contacts 2-3, a selector wiper, a segment contact, switch contacts 5-4, and a negative terminal; the PR relay begins to pulsate supplying a current by pulses from the positive terminal of the battery to the EM winding of the selector along circuit No. 7 in which are a positive terminal, RK contacts 11-12, PR contacts 2-1, a 100 ohm resistance, the selector EM winding, PO contacts 1-2, a selector wiper, a segment contact, switch contact 5-4, and a negative terminal. Having received the pulses, the selector electromagnet moves the wiper along the segment contact blank which is connected to the cable cores. Alternately switching to all of the cores, the wipers form circuits corresponding to circuit No. 5. If the cable cores are not in working order, a lamp corresponding to the ordinal number of each core is illuminated on the device.

Having checked all of the cores in this manner, the selector is stopped since the wiper falls on a dead contact and in this way opens all of the circuits except for circuit No. 1.

If wiper "a" falls on a broken core, circuit No. 5 is broken: no current is supplied in the RO relay and spring 2 is moved from the first contact to the third breaking circuits No. 6 and No. 7. The selector, stopping at the core which is out of order, activates signal circuit No. 8 (positive terminal, bell button which is tied in parallel to its damage lamp, RO contacts 3-2, wiper "d", a segment contact, switch contacts 5-4, and negative terminal). As soon as the signal circuit is closed, the damage lamp flashes and the bell rings.

In case wiper "a" falls on cores which are intercirculated between each other, their indicator lamps are illuminated. Circuit No. 3 receives a 250 milliampere current which activates the RK relay to activate circuit No. 9 (positive terminal, bell, bell button connected in parallel with its damage lamp, RK contacts 1-2, negative terminal). With this also, the damage lamp flashes and the bell rings.

If the start button is pushed while the selector is stopped at a core which is out of order, the selector will resume its movement. In order to change the speed of the movement of the selector, it is only necessary to push the proper button.

Various cables can be checked with the described device. All that is necessary is to build a connecting contact block for the given cable into it or to prepare a connection device.

Automatic Slide Projector of Simple Construction -- by Capt Tech Serv A. F. SHUMSKIKH and Tech-Sr Lt V. I. ZURIN (Page 71)

Abstract:

Describes the circuit and internal and external details of a slide projector of simplified construction.

CYBERNETICS AND AUTOMATION

[An editorial note explains that Cybernetics and Automation is a new column initiated in this issue in response to requests from readers and asks for comments or further requests.]

Cybernetics as a Science of the Structure of Control Processes and of the Properties of Control Systems -- by Engr-Col N. P. BUSLENKO, Professor and Doctor of Technical Sciences (Pages 72 - 77)

Text:

Modern warfare , which is based on the use of new means of combat including nuclear and rocket weapons, may acquire a flexible, dynamic, and highly maneuverable character from its onset. It will be noted for the increased possibilities of powerful strikes both against roops and against deep rear areas of the combatant countries. The work of commanders, staffs, and all organs of troop control will also undergo essential changes in this connection.

Under the new conditions of waging armed combat, information concerning a military situation which arrives from various sources is so diverse and extensive that it is necessary to use the latest means of automation and electronic computer equipment for the prompt processing, evaluation, and comprehensive utilization of information to increase the effectiveness of control and to organize combat operations more expediently.

The use of these means and their maintenance poses problems for commanders, engineers, technicians, and all personnel, which can be solved only on the basis of an extensive theoretical and general technical background, and sufficiently and comprehensive orientation in all new branches of science and technology, including the numerous problems of cybernetics.

Cybernetics is the science concerned with the structure of control processes and with the general properties of control systems. It explores a very wide range of phenomena and processes which occur in practical systems. It investigates the control processes which are peculiar to various mechanical and electronic systems, to technological and production complexes of industry and transport-, to chemical and nuclear reaction, to complex economic systems, and even to phenomena which occur in nature. Obviously, the phenomena inherent in such diverse systems differ significantly from one another by their specific content. However, if one disregards specific properties of mechanical, electronic, chemical, biological, and other phenomena, some general features inherent in any control process can be discovered. Cybernetics explores the processes of control and the properties of control systems from the point of view of their capabilities to sense information concerning conditions both of external environment and of the system itself, to store this information in its "memory", and to process it into appropriate control signals. Military cybernetics has the task of preparing practical recommendations for improving control of troops and combat means by using the latest achievements of information and computing technology.

The basic idea of cybernetics is the idea of control system. A control system is an aggregation of elements which are unified into a single pattern and have a definite function, connected with the sensing, storing, and processing of information.

The practical control systems of interest to us here usually prossess elements which are sources of information and, under the influence of the external environment and other elements of the system itself, process information concerning the conditions of the external environment and of the control system. This information is fed to means of transmission and storage of information. The sources of the information are sometimes termed input signs of the control system and the means of storing the information are termed the memory of the control system. Usually, memory is divided into external memory and internal memory. The external memory is able to record information supplied from the signs, but the internal memory cannot sense it directly. The system has a control element which processes information concerning conditions of the external environment and of other elements into control signals which are intended for the control of the actuating mechanisms.

Operation of a control element is governed by definite rules which regulate the processing of information and is closely connected with the condition of the internal memory of the system. Control signals influence both the actuating mechanisms and other elements of the system. Under the influence of control signals, the actuating mechanisms perform stipulated operations. Also, the system itself, under the influence of control signals, is subjected to reorientation: its structure, the condition of its individual elements, the rules for information processing, etc. can be changed. From this viewpoint, it is reasonable to speak of an evolution of the control system. It is obvious that the control system can evolve in various ways depending upon the information arriving from the external environment.

An important feature of a control system is the presence of so-called feedback. The sources of information produce information concerning the conditions of both the external environment and elements of the control system. Therefore, it is possible to check the course of the control process and to consider the actual condition of the actuating mechanisms during processing of the control signals. The actuating mechanisms are a means of reciprocity of the control system with the external environment. Often, this reciprocity consists of the system giving out information produced as a result of the processing of the input information. Therefore, the actuating mechanisms are sometimes called the output signs of the system.

A complex control system can be broken down into parts or subsystems, each of which is a control system in itself with corresponding signs for communication with other subsystems. In examining actual systems, we find that their control systems often concern various levels of control: there can be low-level systems, each of which is concerned with an individual group of identical objects; and there can be high-level systems which issue control signals to subordinate systems of a lower level. For example, any air defense system consists of means of target detection, information processing, and control, as well as of active means enabling target destruction.

According to the above definition it can be ascertained that the air defense system, from the cybernetics viewpoint, is a complex control system which can be broken down into the subsystems referred to in the example. Each subsystem is essentially an independent control system possessing input and output signs, memory, a control element, etc. Each of these subsystems has its own determined function and processes corresponding information.

An analogous subdivision into subsystems can be continued even further. Thus, the system for target detection consists of individual means of observation, and the system for active means [of destruction], in turn, is an aggregate of individual elements or complexes, etc.

In this connection, it is not too difficult to identify the various control levels in the given case. It is evident that the system for information processing and air defense control is the control element of the higher level and that the control elements of the subsystems are the controls of a lower level. If consider the air defense of a certain region, such as the total of all inter-connected systems for the defense of certain objects, we encounter a still higher control level. In other words, we are dealing with a hierarchy in the structure of a control system.

In examining any control system, we, as a rule, know its purpose and several general properties. We also have a superficial idea of the principles of its structure and functions, which is drawn chiefly from the experience of observing analogous systems. It is necessary to gain exhaustive information concerning the structure and functions of a control system and also to produce its mathematical description, suitable for subsequent cybernetic research.

The measures related to the study of a control system can be separated into two groups depending upon the approach. Let us consider the method of study of a control system by means of the micro-approach, i.e., consideration of the system as a single unit, and by means of the microapproach, which is related to penetration of the internal structure of the system.

In the microapproach, a control system is studied externally by examining its external properties. In this approach, the input and output signs of the system, its external memory, and also its behavior, are accessible for direct observation.

Usually, the purpose of studying a control system with the macronapproach is to resolve the following problems: to ascertain the information flow; to disclose the information code; to reveal the functions of the control system; and to study its operation. Only the first two problems can be fully solved with this approach. A solution of the other two problems is only begun with the macronapproach, but it can be completed by the microapproach.

Ascertainment of the information flow is essentially the first step in the diagnosis of the arrangement and functions of a control system. First, it is necessary to determine the purpose of the system and to determine more accurately its role in the process under consideration. In this case, it can be learned what information is necessary for functioning of the system, and the information which is not necessary should be filtered out. In connection with ascertaining the information flow, it is also possible to determine the elements of the system which are connected with the input, output, and the storage of information, i.e. the signs of the system and its external memory. It can also be learned which signs are input and which signs are output.

Functioning of the control system is accompanied by the sensing storage, processing, and reading out of information, which is expressed by several sequences of elementary signals constituting a definite code. There are various systems for the coding of information, received from outside, stored, in the external and internal memories, and then subjected to processing and reading out. The code for input and output of information, and also for the storing of information in the external memory, can be disclosed by the macroapproach. After ascertaining the information code, an algorithm of its coding and decoding must be determined, i.e., the sequence of operations and the rules for processing information in the given system.

It is necessary to determine the relation between the input and output of information to reveal the functions of the control system. Without knowing the rules for processing of information, the function of the system cannot be fully determined with the macropproach. However, a sufficiently general idea of the function of the system can be achieved by experimental menas for given sets of input information, one may determine matching sets of output information. A certain output signal, or a certain assessment of an output signal, can be matched to each signal. In some cases, a very large number of experiments are required for full determination of the function of a control system or it may be prove to be theoretically impossible.

It may be noted that an interpretation of the results of the above mentioned experiment sometimes makes it possible to obtain indirect data concerning the internal structure of a control system. For example, it can be established whether the system includes feedback, the capacity of the internal memory can be approximately evaluated, the time regime for information processing (tempo, delay, etc.) and the traffic-carrying capacity can be estimated, etc. All of this leads to an understanding of the functioning of the control system.

However, the macroapproach has limited possibilities. A deeper study of a control system can be made by means of the microapproach which presents a basis for familiarization with the internal structure and the functioning properties of the elements of the system. It does happen that, for reasons beyond our control, the microapproach cannot be used. Therefore, the development of theoretical and experimental methods of investigating control systems with the macroapproach, is of great value. Although these methods are not comprehensive, they are adequate.

The microapproach is concerned with the following problems: finding the elements of a control system and their interrelationship; discovering the function of the system and the method of its functioning; and preparing a formal, mathematical description of the functioning process of the system.

Finding the elements of a control system is always connected with breaking it down into subsystems which can be considered elementary control systems. If the subsystems are large, a total representation of the system can be so broad that many important factors are not taken into account. In the case of the subsystems being very small, a general representation of the system can be very detailed, but the handling of such a system would be too cumbersome. An optimum subdivision of a system is accomplished by considering both of the mentioned circumstances. Study of elementary control systems (elements of an initial system) is done with the macroapproach, as a rule by experimental methods.

After the elements have been ascertained, it is necessary to find the connections between them: schematic connections, information exchange, dependence of the functioning regimes of one type of elements on the conditions of other elements, etc. Special attention should be paid only to essential communications. As for unessential, secondary communications, it is usually a hindrance to consider them, since this only complicates the understanding of the functioning process of the system.

Interpretation of the results received by finding the elements of a control system and the connections between them results in a final determination of the function of the control system and exhaustive information on its functioning.

With this, an informal, descriptive study of a control system may be considered completed. Further solution of the problems must be accomplished by using a formal mathematical description of the functioning process of the system. For this purpose, it is necessary to construct an aggregate of mathematical relations or an algorithm with which, according to given input information and knowledge of the condition of the system at any moment, output information and knowledge of the condition of the system at any moment of time can be derived. The structure of a mathematical description of a system with the use of a digital computer allows a reproduction of the circulation and processing of information which, according to its properties, approximates the processing of information in an actual control system, regardless of whether the system is in existence or imagined. Thus, it is possible to model the processes of the functioning of control systems.

For control systems which are of greater interest from the military point of view, the construction of a mathematical description is usually accomplished in the following manner. First, the characteristics of the input information are clarified, i.e., the condition of the external environment and the elements of the system. This includes composition, volume, and frequency of succession, and also precise characteristics, etc. Then, algorithms for the coding and decoding of information are registered and parameters or coordinates which characterize the conditions of the elements of the system (signs, memory, etc.) are selected. After this, algorithms for the processing of information and for the determination of coordinates in new moments of time, depending upon input information and the coordinates in previous moments of time, are registered.

A mathematical description or a mathematical model of combat actions can be used for the substantiation and evaluation of new regulations for the control of troops resulting from the use of new types of arms. Mathematical models are also extremely useful for the evaluation of the effectiveness of combat methods and means, since they permit a great reduction in the range and troop testing programs. Mathematical models can also be used to choose optimum variants for executing combat operations in any specific combat situation.

However, since mathematic modeling enables the determination of only average stable indices for a large number of single-type combat actions occurring during identical situations, and the finding of probabilities for obtaining these indices, it must be applied mainly for research on the comparison of various variants for conducting combat actions with one another, and for preparing proper recommendations. The basic criterion for evaluation must of course be the quality of the execution of combat assignments.

An extensive mathematical system is used for the mathematical description and modeling of control systems. Thus, the theory of probability or the theory of random processes, and also the information theory, play a paramount role in describing information flows, questions of coding, transmission and storage of information, and determination of volume content, and exact characteristics. The concepts and methods of the theories of relay-contact circuits, dynamic systems, graphs and networks, finite automata, and the queuing theory, etc. are widely used for the formalization and mathematical description of the processes of the functioning of control system elements. When discussing the formal description of mthods of processing information and of procuding control signals, the results of the theory of games and statistical solutions, theories of linear programming, methods of convex and dynamic programming, the method of sequential analysis, etc. are employed. Finally, mathematical logic and the theory of algorithms play an essential role in many questions concerning the mathematical description of control systems.

Proceeding to the consideration of basic problems connected with the investigation of control systems, we note that their solution is possible both by mathematical description and without it. The difference will be only in the exactness of the achieved results and in the depth of the study of corresponding rules. Usually, rough, superficial results may be achieved without the use of a mathematical description.

It is expedient to distinguish two important classes of problems: problems concerned with the analysis of control systems and problems concerned with their synthesis. The problem of the analysis of any control system is, in general, the study of its properties. From this point of view, all of the steps mentioned above in connection with the macroapproach and the microapproach may be fully applied to the analysis of systems. However, they do not exhaust all of its possible aspects.

Earlier, we discussed only those problems of analysis which are resolved by experimental means. With the use of a mathematical description, a number of problems may be formulated which do not require experimentation for their solutions. The only exceptions are cases when it is necessary to experiment in order to make the mathematical description itself more precise.

The most important problems of the analysis of control systems connected with military matters are the problems of defining functions which describe various aspects of the functioning quality of systems. These characteristics, which are usually called indicators, can be achieved by means of calculation derived from algorithms which describe the operation of a system, or by means of a method of modeling.

The basic quality of a control system is its affectiveness. The indicators of effectiveness are usually the quantities which evaluate the degree of conformity of the properties of the system to its purpose. For example, for a ground-to-air guided missile complex, an indicator of effectiveness is the probability of target destruction; for an air defense unit defending an objective--the probability of the preservation of the objective; for an air defense system assigned to attack an enemy aerial unit--the mathematical expectation of the number of targets destroyed; for a queuing system - the average time of waiting in line; etc.

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Apart from the general evaluation of the effectiveness of a system, the influence of some factors on the quality of its operation must often be determined. For example, the evaluation of reliability, durability, independence, and other important properties of actual systems has large significance. To evaluate reliability, it is necessary to have time probability characteristics of faultless operation for all of the assemblies, stages, and other primary elements of the system. Knowledge of these makes it possible to formulate some idea concerning the reliability of the system as a whole; however, this will be very superficial in the case of complex systems. In order to draw important practical conclusions concerning the reliability of a complex system, it is necessary to determine the relative influence of its individual elements on the effectiveness of the system as a whole.

A quantitative measure of system reliability can be the difference between the value of the system's effectiveness indicator (in conditions where all elements have ideal reliability) and the value of the effectiveness indicator which conforms to the actual reliability of the elements. It is analogous in the case of other system qualities. A quantitative measure of durability can be the difference between the values of system effectiveness indicators (in conditions where all elements have ideal durability) and the value of the effectiveness indicators corresponding to the actual durability of the elements, etc.

Knowledge of the influence of various factors on the effectiveness of a system makes it possible to solve many practical problems. Thus, valuable recommendations can be achieved in matters concerning the optimum combat use of different systems, and determination of the most expedient regimes of equipment utilization, and also conclusions which have value in the developing and testing of prospective means and methods.

We note that the range of problems, connected with determination of effectiveness indicators for various systems and also with the achievement of practical recommendations by analysis of the dependence of effectiveness on various factors, represents a scientific sphere which is closely related to cybernetics and is known by the term "operations research."

Operations research concerns problems of the most expedient use of arms or equipment and the best organization of economy as well as combat actions. For this reason, the term "operations" is used in this context in a broader sense than was customary until now in military matters. It implies any organized, purposeful activity of personnel under a single control. The most fruitful application of methods of operations research is to those types of operations which are characterized by repetition and the presence of a large amount of complex technical means.

In general, the problems of control system synthesis can be formulated in the following manner: a system possessing certain properties must be constructed from a collection of standard elements which have

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known characteristics. So that the problem of synthesis may have exact meaning, a criterion of system effectiveness must be chosen and the conditions or limitations imposed on the system must be recorded. Then, the formulation of the problem of synthesis takes on the following aspect: a system must be constructed from a given collection of elements so that it will have the best possible effectiveness in conditions where all imposed limitations have been met. Weight, size, power consumption, equipment cost, cost of operation, etc. are properties which are usually subjected to limitations in an actual system.

The synthesis of control systems is of special importance for solving various questions of control automation. A typical problem of this type is the determination of optimum structure of control information flow (centralization of control). Let us imagine a hierarchical control system composed of three control levels: lower, intermediate, and higher. If basic control problems are resolved at the lower and intermediate levels, there is a danger that the quality of control will not be sufficient, since the control elements of the lower and intermediate levels do not have information available concerning the conditions of all adjoining elements of the system. On the other hand, when the majority of control operations are concentrated at the higher level, it is necessary to transmit and to process enormous quantities of data which are supplied from the information sources of a lower level.

The problem of synthesis in this case can be formulated by various mthods depending upon practical requirements. For instance, a question can be posed concerning the structure of a system with the highest quality of control in conditions where the volume of transmitted and processed information does not exceed the requirements. Another problem may be formulated: a system must be constructed with a minumum volume of transmitted and processed information in conditions where the quality of control is maintained at a given level. Finally, a system can be considered which has the highest possible quality of control, but the volume of information is restricted only to a level where the quality of control is not noticeably deteriorated, etc.

In practice, a combination of modeling methods (for appraisal of qualities of variants) and methods of linear or dynamic programming (for choice of an optimum variant) is usually used for the solution of problems of control system synthesis.

As mentioned earlier, under the influence of control signals, a system is generally able to rearrange its structure and change the values of parameters. The conferring of properties of self-adjustment and self-instruction as a means of adaptation to changing conditions of the external environment and as a means of perfecting principles of control, is an essential condition for the synthesis of control systems. Optimum methods of coding information also play an important part.

Lately, research activities connected with the modeling of various aspects of mental activity have appeared in cybernetics, i.e., the synthesis of those control systems which can reproduce individual functions of thought in a formalized manner. A study of the properties of these control systems will further the perfection of the principles of automated control which are used in practice.

The practical significance of cybernetics as a science concerned with the structure of control processes and with properties of control systems is the fact that a study of the principles of control, which are peculiar to phenomena of a diverse nature, allows deeper penetration into the essence of control processes and reveals unknown natural laws in the functioning of control systems, which are useful from the viewpoint of the supremacy of man over nature.

On the Book Shelf (Page 77)

Abstract:

Gives brief descriptions of the following books and brochures published in the fourth quarter of 1962 by Voyenizdat:
Avtomaticheskoye izmereniye chastoty (Automatic Frequency Measurement) by I.V. BOGDANOV (85 pp., 16 kopecks), concerns automatic instruments used for meansuring frequencies of electric oscillations.
Elektronuyye tsifrovyye vychislitel'nyye mashiny [Electronic Digital Computers] by Yu.G. CHUGAYEV and V.A. PLISKO (405 pp., 1 ruble), describes the construction and operation principles of electronic digital computers.
Poluprovodnikovyye preobrazovateli napryazheniya [Semiconductor Voltage Transformers] by E.A. ISAYEV (109 pp., 19 kopecks) concerns the construction and operation principles of semiconductor voltage transformers used for power supplies from low-voltage, direct-current sources.
Poluprovodnikovyye pribori v apparature svyazi [Semiconductor Instruments in Communications Equipment] by I.A. BRATSLAVSKIY (125 pp., 34 kopecks), discusses the characteristics and use of semiconductor instruments in individual components and elements of communications equipment.
Elementy diskretnykh sistem svyazi [Elements of Discrete Communications Systems] by V.I. SHLYAPOBERSKIY (230 pp., 61 kopecks). "The author has intelligibly expounded the basic ideas and definitions of discrete (code) systems of communications, questions of coding, methods of transmission and reception of coded information, equipment elements, construction principles, and circuits of basic system components."
Infrakrasnyye luchi v voyennom dele [Military Use of Infrared Rays] by V. Ye. KICHEK (or KICHOK) (175 pp., 32 kopecks), concerns the construction of infrared devices for various military purposes and the electric power supplies for such devices.

REVIEWS AND BIBLIOGRAPHY

Beloved Traits -- by Col (Res) N.F. POLTORAKOV (Pages 78 - 80)

Abstract:

Reviews the 1963 Gospolitizdat publication O Vladimire Il'iche Lenine (Vladimir Il'ich Lenin) which is a collection of articles concerning Lenin and his activities during the years 1900 to 1922. Articles by N.K. KRUPSKAYA, Ye. D. STASOVA, G.I. PETROVSKIY, F.N. PETROV, A. V. LUNACHARSKIY, and A.M. KOLLONTAY are included in this book.